Fostering parental involvement in children's mathematics homework in Singapore pre-primary education: an intervention using parental education and school-home communication

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FOSTERING PARENTAL INVOLVEMENT IN CHILDREN'S MATHEMATICS HOMEWORK IN SINGAPOREAN PRE-PRIMARY EDUCATION: AN INTERVENTION USING PARENTAL EDUCATION AND SCHOOL-HOME COMMUNICATION

By

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DECLARATION

The thesis results from my own work and has not been offered previously in candidature for any other degree in this university or any other university.

Statement of copyright

Abstract

The intent of this study was to compare two different types of parent involvement strategies: Parent Education Workshops and communication through newsletters and the impact they have on children's math achievement and parent efficacy, parent encouragement and parent home involvement.

Participating in the study were 259 children, 5 to 6 years old and their parents, who were assigned to three experimental and one control group. The study adopted a randomised pre-test, post test 2x2 factorial experimental design with control group.

A self-developed criterion-referenced math assessment containing 58 test items was used to measure children's knowledge of basic math concepts. A self-administered parent survey to measure parent confidence, parent encouragement and home involvement adapted from Hoover-Dempsey's scales for measuring parent mechanisms of involvement was modified and used for this study. Both the math assessment and the parent survey were administered as a pre-test and post-test.

Three parent training sessions modelled on the Berkeley Family Math programme were conducted over a period of 4 weeks for parents in the workshop and workshop*communication groups on how to help children with math at home. Parents who attended the workshops were provided with take home math kits designed to enable parents to use developmentally appropriate materials and activities to encourage their children's interest in math. The communication and workshop*communication groups received three issues of newsletters that contained information and ideas for parental involvement to help children learn math at home.

The results of the study showed significant gains in children's math where both the workshop*communication conditions were present, in particular for children with lower pre-test math scores. No significant effects of the treatment on the three parental variables were found. Qualitative data collected from parents and teachers indicated that the parent education workshops had positive results and impact on parents' self efficacy.

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"If I have seen further it is by standing on the shoulders of giants. " Isaac Newton

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To God Almighty, who makes all things possible in His time and whose grace is sufficient for me, praise and glory belong to Him.

1. INTRODUCTION

Background to the research study

This thesis investigated the effects of two types of parental involvement (parent education and school-home communication through newsletters) on :

1. children's math learning and
2. parents' reported self-efficacy, parent home involvement and parent encouragement related to their involvement in their children's education and learning.

The study intended to contribute new knowledge by assessing the differences which the two types of parent involvement (and a combination of the two), considered to be the more common types of strategies adopted in pre-primary settings in Singapore, have on children's mathematical development. The findings would hopefully be helpful in informing educators on the planning and preparation of effective parent involvement initiatives and decisions that affect the allocation of resources of time as well as teacher training.

Investigator's Interest in the Topic

The investigator's interest in the topic arose from her own role as an educator and experience of having run child care centres for more than 10 years. Having developed and implemented various parent involvement projects and initiatives to help parents become more interested and involved in their children's education, the investigator wanted to find out which types of involvement were more effective in promoting children's mathematical development.

As a teacher educator, the investigator has also designed and delivered courses on Building Home School partnerships as well as conducted parent education talks, including make-and-take lunch-time talks for parents at a workplace childcare centre. From the interactions with parents of children of preschool age, the investigator has encountered parents' expressed interest to support and be involved in their children's education, especially in helping their children transit smoothly from the preschool to the primary school setting.

Drawing from both the interactions with parents and the literature that have been studied in the course of preparing for the courses she taught, the investigator was of the opinion that not all types of parent involvement activities are equally effective for the purpose of promoting children's learning and educational outcomes. The investigator was interested to find out which types of parent involvement, would be most suited and effective towards helping parents in Singapore become more efficacious and confident in their role in supporting their children's education and learning in math.

In addition, through reviewing the research in this area at the start of the study, there was clearly a lack of published local research studies conducted in this area of parent involvement and children's mathematics learning which examined the different types of parent involvement and their impact on children's math achievement and parent self-efficacy in helping their children's math learning. Hence, this study would be a useful source of reference for educators and researchers interested in this topic.

Rationale for study

In addressing the issues of school transition from preschool to primary one, as well as the importance of parent involvement, some concerns facing both educators and parents are :

1. What are the competencies that children need to bring with them before they enter primary school ?
2. What knowledge, resources and materials can preschools provide parents and families to help them develop these competencies in their children ?

Since parent education and family support programmes are viable ways to strengthen readiness for school, how can preschools help to:

1. Facilitate and support the family and the home environment and mobilize it to support school readiness in the area of developing numeric understanding and skills ?
2. Improve the provision of supportive environments in the home and involve families in preparing their children for Primary one ?

In designing programmes of home-school-community partnerships, schools cannot assume that one type of involvement or a single activity will positively affect student achievement in all subjects. Studies indicate that different types of involvement activity have resulted in different outcomes (Epstein, 1995), such as math achievement and grade point average (Catsambis, 2001, Desimone, 1999; Lee, 1994). Hence, there is a need for more research to generate better information about the results of specific involvement activities, so that more educators would be able to select and implement those most likely to achieve the goals they have set for their students.

This study aims to find out which type of school-initiated parent involvement programmes (in the areas of communication and Parent Education) can promote parent involvement and the impact this has on parental efficacy for helping children's learning at home, parent role construction of encouragement in relation to children's education and student achievement in mathematics). The objective of the parent education programme in this study aims to offer groups of parents of 6-year olds the opportunity to work more closely with the schools in ways that will enhance their involvement in their children's math learning at home. The intervention programmes designed and developed for this study focused on creating opportunities for more information exchange between school and home especially in the area of helping children with math in the home.

Issues in Transition from preschool to primary school

Each year, about 50,000 children transit from the preschool and childcare centres into the formal school system at Primary One (P1) in Singapore. (MOE, 2003). For many 6-year olds, the transition from preschool or home to Primary One can be demanding. Children face new expectations for independence and responsibility, as well as educational goals that are more formal than those in preschool. They must also learn to interact with teachers in ways that centre around academic progress and often face larger class sizes as well. (Rimm-Kauffman, 2000).

Children entering primary one come from different family backgrounds and levels of school readiness as preschool education in Singapore is not compulsory and there is no mandated curriculum or standardized measures against which preschools can benchmark their programmes[1]. Children in most preschools transit from a less formal and play-based curriculum and programme to a more formal and structured experience of schooling, having to cope with a maths curriculum[2] that places a greater emphasis on the abstract and symbolic level in teaching and assessment rather than at the concrete level. This poses a challenge for children who may not have had a good foundation in language and mathematical concepts e.g. rational counting, cardinality principle of numbers, sequencing, sorting /grouping objects, concepts of more than, less than, counting back and forward etc.

During these transitions, parents are often unsure what is expected by their children's new teachers or how to help their children in new

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[1] The Ministry of Education provides a set of guidelines for preschool curriculum but does not make it mandatory for all preschool and child care centres to adopt. For the material, please refer to the website : http://www.moe.gov.sg/preschooleducation/curriculum_framework.htm

[2] Please refer to Appendix A for the Primary One Math syllabus, p. 281

schools and grade levels. This is particularly so for preschool children entering primary one.

School readiness is generally referred to as the conditions that promote children's readiness to succeed in school (Jenkins, 2003). At its core, readiness is multifaceted, complex, and systemic, combining

- A child's experiences at home and the resources of the home,
- The resources and experiences present in child care and preschool settings attended by the child;
- Community resources that support high-quality parenting and child care;

Children's preparedness and success in school depend on the quality of experiences and opportunities that take place before they enter school. Research has shown that high quality early education experiences in families, childcare, preschool and early elementary settings do help prepare children to succeed later in school (Miesels 1999; Shonkoff and Phillips, 2000).

The experiences that children have in their homes with their families are by far the most important influence on the readiness competencies. In particular, parents' sensitive interactions with their children are an important developmental 'input' to the growth of pre-academic as well as social behavioral competencies (Pianta 2002).

The topic of parent involvement and better home-school partnerships have also been stressed by both political leaders and policy-makers in Singapore, who have emphasized the importance of adopting home-school partnerships as a strategy to help improve student achievement.

Former Senior Minister of State for Education, Aline Wong, recognized that "there are important *pre*-reading, *pre*-writing and *pre*-arithmetic skills to be learnt before a child can read, write and do sums. We need to give adequate attention to these critical fundamentals." Her plea to parents " to work hand in hand with the (preschool and child care) centres, and later on with schools, to provide the best learning opportunities and experience for their children" is a necessary one. It must be remembered that Pre School Education is only one factor of success in learning. Home support for children is equally, if not more, important." (Wong,2000)

The current Minister for Education, Mr Tharman Shanmugaratnam also argues for the importance of building positive home school partnerships to improving pupil school achievement :

> "If there is one consistent and categorical finding in studies of educational achievement, it is that the engagement of parents matters, regardless of race or socioeconomic background. Children are better motivated at their studies, and eventually do better, when parents continually monitor their children's work, encourage them on, and give them the love and care they need when young. (Shanmugaratnam, 2005)
>
> "Collaboration between PSGs (Parent Support groups), community organizations and schools to promote parenting skills will pay off for our children. Engaged parents - parents who talk to their children about what they have done in school, monitor their progress and constantly support them and encourage them on - have better achieving children, in every socio-economic group." (Shanmugaratnam, 2003)[3]

Competencies that children need at the Primary level

A review of the Primary One (P1) Math syllabus, shows an extensive list of content and expectations of what a P1 child will be learning (Appendix A) as compared to what children are expected to learn before they enter Primary One. The Foundation Stage (P1-P3) covers considerable amount of content and problem solving skills. All subjects, with the exception of the Mother tongue languages, are taught in English. Hence, children who come from non-English speaking and disadvantaged homes may find the content and concepts a challenge to grasp and acquire.

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[3] Cited from Speech made on 13 September 2003

As preschool education is not compulsory in Singapore, it is estimated that 5% of children who do not attend pre-school[4] may enter Primary One without any preschool experience or adequate school readiness skills.

Unless there is a conscious effort to educate and inform parents of Kindergarten 2 children entering P1 of this marked difference in terms of cognitive expectations and the gap in the mathematics curriculum between the preschool and primary schools, parents will remain unprepared in terms of what is to be expected of their children. Many parents who do not have any prior experience of a child in the primary schools would be unfamiliar with the new mathematics syllabus taught in the Primary schools.. A lack of knowledge and understanding in this regard will put both parents and their children at a disadvantage especially if they do not understand how they can help their child.

To quote the Minister of Education, Tharman Shanmugaratnam on the importance of Mathematics, he said,

> "As a subject, Mathematics matters to our young, not just because improved performance in Maths will raise their 'O' and 'N' Level aggregate scores, but because Mathematics is important as a foundation for further learning, in our universities, polytechnics and ITEs (Institute of Technical Education). Along with Science, Mathematics remains the foundation subject for most developments in an innovation-based world." (Shanmugaratnam, 2005)[5]

Given the social importance of mathematics, science and technology knowledge, it is essential to establish competence in a subject area early and to ensure that there is greater attention paid to the preschool math curriculum.

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[4]Shanmugaratnam, Ministry of Education, May 2006

[5] Cited from a keynote speech made on 19 Feburary 2005

Given that high quality pre-school education can bring children to an appropriate level of school readiness, pre-schools should aim to help families to support their preschool age children acquire the basic core competencies and knowledge to adjust and cope in a very different learning environment and assessment in the Primary One school system.

Home-School connections to support children's school readiness

Given the importance of school readiness, it is imperative that schools and educators take positive steps to develop appropriate parent education and support programmes to enhance involvement at home to provide positive pre-primary experiences for all children. Combining learning in school and learning at home can and should begin early in a child's learning career, and as educators, there is a need to assist parents in teaching their children mathematics skills by relating everyday experiences and routines to mathematics.

One of the reasons why 'at home' involvement is significant in promoting achievement and adjustment could be that for younger pupils, parenting provides the child with a context in which to acquire school related skills and to develop psychological qualities of motivation and self worth. As the child's first and most important teachers, parents provide the experiences that promote life skills, abilities and attitudes that underlie school success. (Pelletier and Brent, 2003).

Parent Involvement in children's education :

There is a supply of untapped parental assistance available to teachers that may be especially useful in improving the skills of average and below-average students who could do better with additional time and well-guided attention.

Parents can play a role to encourage, support and motivate children to learn maths concepts and reading skills. Teachers can provide this help and support through sharing of knowledge and teaching approaches e.g. how to make learning materials, offer parent training workshops and share 'success' stories of how some parents have found effective ways to help with children's homework and learning at home.

In addition, with the large class size in both kindergarten and Primary One classes, it is important that parents become involved, on a 1-to-1 basis to support their child's learning at home, since the class teacher, due to the large class size, is unable to devote the same intensity and level of attention to the child that a parent can. However, parents are often unsure as to how to help their child to be prepared for a more academic curriculum and how to keep up and cope with the new ways of learning and supporting children's learning at home.

Epstein (2001) observed that an important correlate of homework and discipline problems is the lack of educational trappings at home (e.g. books, tools, maps, dictionaries etc). Teachers who need parental help in solving student homework and discipline problems may need to find ways to make educational resources available for use at home, or at least help parents be aware of the existing resources in their homes that can be used for education purpose.

In a parent satisfaction survey conducted prior to this study in 2002 by the childcare organization which the investigator works for, parents voiced their concerns that their children were given too little homework and were worried that their children would not be able to cope with homework later when they entered primary school. Parents have also made suggestions to participate more actively in their children's learning, either at the centre or at home. Requests for better communication from the centre to inform parents of their children's progress and homework matters were also made.

The aim of this study is to explore how the two types of parent involvement and a combination of these two types would affect :

1. Children's Mathematical development
2. Parent Confidence /Self efficacy
3. Parent Home Involvement
4. Parent Encouragement

To address some of the methodological shortcomings[6] pointed out by Baker and Soden, (1998), which include the lack of experimental studies conducted on the topic, this study adopted a 2x2 factor experimental (pre, post) design to compare the effects of the different types of parent involvement (Communication and Home Learning) on the abovementioned variables.

In summary, by knowing which type of parent involvement has a greater impact on student outcomes and school-home practices, schools will be able to help parents similar to those in this study support their children's learning, and hopefully, in easing the transition from preschool to primary school for the 50,000 children each year. The benefit of this study is envisaged to contribute to the existing body of knowledge by :

1. Building on existing knowledge and contributing towards a better understanding of which type of school-home partnerships and parent involvement activities are most effective for helping children transit to primary one.
2. Finding out how parents and schools can help support their children's (6-7 years olds) mathematical development. at home.

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[6] Refer to pp. 56-57

Outline of the Thesis

The following Chapter 2 will summarise and present the relevant literature that outlines the conceptual framework and theories that are relevant to this study and which have helped to inform and shape the design of this study. Examples of key studies that have been conducted in the area of parent involvement at home and various Family Math programmes to help parents support young children's math learning at home will also be presented. Following that discussion, the research questions for this study are also presented.

Chapter 3 will describe and provide a framework for the research design and how the procedures selected for this study were implemented in order to address the research questions. The chapter will describe in detail the selection of the participants for this study, the instruments developed and used for this study as well as the constraints faced by the investigator.

Chapter 4 through 6 will present the feedback from both parents and teachers on the interventions as well as the findings and interpretations on the key outcome variables that will address the research questions pertaining to the children's math achievement and parents' self efficacy, parent involvement and parent encouragement.

Finally, chapter 7 discusses the results of the study and concludes with the investigator's own reflections of the implications for planning and conducting parent involvement programmes in light of what has been learned in the study as well as propose areas for teaching practice and potential future research in the area of parent involvement at home.

2. LITERATURE REVIEW

Introduction

This chapter reviews the relevant studies conducted on the topic of parental involvement. It aims to present a case for the importance of parent involvement and its benefits and relevance to children's learning outcomes and school readiness. As the investigator is interested to find out which kind of parent involvement is more effective in helping prepare preschool children to transit into primary school, particularly in the area of mathematical learning, the theme of the literature review is organized as follows.

Firstly, (1) a review of the literature pointing to the importance of home-school connections and its impact on helping children becoming ready for school will be discussed. In particular, (2) the impact of parent education programmes on children's learning outcomes studied in various countries and (3) a theoretical framework for this study will be presented. This is followed by a discussion on (4) the definition of the different types of parent involvement as well as the rationale for choosing the two types of parent involvement for this study. The chapter concludes with (5) a brief outline of the gaps found in past research as well as the (6) research questions formulated for this study.

Importance of home school connections on school readiness

The importance of parent involvement has been documented in three decades of research and have demonstrated that parent/family involvement significantly contributes, in a variety of ways, to improved student outcomes related to learning and school success. When parents participate in their children's education, the result is an increase in student achievement and an improvement of students' attitudes. The effects of increased parental involvement in children's learning overwhelmingly demonstrates that it is positively related to achievement (Henderson & Berla, 1994). Further, the research shows that the more intensively parents are involved in their children's learning, the more favourable are the achievement effects.

School transitional practices also have an impact on a child's school readiness. Children's success in school can be linked to effective transition practices and activities. A child's competencies that he or she brings to school is linked to the extent to which the primary school is well linked to family and child care resources and the degree to which the classroom experiences adequately provide for the child in both the preschool and primary school (Love et al 1992; Pianta and Walsh 1996; Miesels 1999). According to Tizard et al. (1988), cited in Aubrey and Godfrey (2003), one of the key predictor of attainment at age seven is the amount of 3R knowledge brought into school, and this emphasizes the importance of the impact of young children's learning experiences between ages of four and seven years.

Readiness and school success are also related to variations in family background (e.g. mother's education, family structure etc) and home experiences (e.g. Parent-child reading) (Brown, 2003). Certainly, this complex mix of factors need to be optimized for children to be successful in school. Since family factors play a critical role in supporting and shaping children's early development, parent education and family support programmes are often viewed as viable ways to strengthen children's readiness for school by giving children the resources and support they need prior to going to school. Hence, in order for children to be ready for school, both home and school will need to interface and work hand in hand to support the child during the transition.

A survey study of children's reading and math achievement in kindergarten and first grade by Denton (2001) showed that children begin kindergarten with different sets of knowledge and skills. Children's reading and mathematics knowledge and skills that differ by child, family and school characteristics at the beginning of kindergarten persist into spring of kindergarten and the spring of First Grade.

Children who bring certain knowledge and skills with them to kindergarten are likely to be at an advantage in classroom learning compared to their peers who do not possess these knowledge and resources. Children who have specific cognitive knowledge and skills, are read to at least three times a week, who possess positive approaches to learning and enjoy very good or excellent general health tended to perform better in reading and mathematics than those who do not have these resources.

Experts point out that without deliberate provision of such supportive environments, no amount of skill-building activities will facilitate children, especially those from adverse home circumstances, to 'readiness'. (Perth-Pierce, 2002).

The key context for parental impact on school outputs is in the home. Other forces, such as information from schools, might be an essential lubricant. Depending on the age or developmental level of the child, parents can and do provide for the acquisition of skills (e.g. Foundations of literacy and numeracy through playing word and number games). Parent Involvement seems to have a major impact on children through the modeling of values and expectations, through encouragement and through interest and respect for the child as a learner (Desforges et al 2003 p. 45-49).

The effect of parental involvement (in terms of providing a home learning environment or HLE) on achievement and cognitive development has been explored in studies of English preschoolers (Sylva et al 1999; Melhuish et al 2001). Higher home learning environment was associated with increased levels of cooperation, conformity, peer sociability and confidence – strongest effect on cognitive development (after age). HLE effect is stronger than that of either SES (socio economic status) or mothers' qualifications.

Zellman and Waterman (1998) explored parenting styles as a predictor of children's reading achievement and concluded that "the parenting processes are independent from family background characteristics such as SES and ethnicity, that parenting style is not enmeshed in a social context defined by poverty or ethnic background which suggests that it might be both teachable and changeable" (p. 379). In other words, good enthusiastic parenting can be found amongst mothers of all social classes and ethnic backgrounds and where it is not found it can probably be taught.

Siraj-Blatchford et al (2002) study on effective teaching strategies showed that it was parental Involvement in learning activities in the home that was most closely associated with better cognitive attainment in the early years. The case studies cited also suggested that when there was a special relationship between parents and professional educators, this was beneficial when a continuity of experience for the children was negotiated between both groups.

Many studies have documented the significance of parent/family involvement in homework. Stearns and Peterson (1973) found that when parents of young children tutored their children, student performance improved. Early childhood, preschool and kindergarten programmes that train parents to work with their children at home tend to have significant, positive effects (Baker et al. 1998, Kagiticibasi et al. 2001; Mathematica, 2001; Starkey and Klein, 2000).

Similarly, Clark (1993) surveyed families of 1,171 third graders and found that the way children spent their time at home proved to be a more significant factor in predicting their success in school than family's income or education level. Families with high achievers reported more time engaged in home learning activities, such as homework, reading and using materials like the dictionary, than families with low achievers. Clark identified the following variables that comprise what he calls 'parents' press' for academic success:

- Parent knowledge about homework assignments
- Parents' perception of child's engagement in homework and
- Parents expectations for child's education

A study that looked at different kinds of invitation and prompts to parents by Westat (2001) found that schools where teachers reported having high levels of outreach to parents (i.e. meeting them face-to-face, sending parents materials that include information on ways to help their child at home and telephoning routinely), showed that the test scores of students grew at a 40% higher rate than those schools where teachers reported low levels of outreach. This finding was also confirmed in a study by Balli et al. (1998) which found that families of students who received prompts were significantly more involved in mathematics homework than families who did not.

Further review of the literature shows that programmes and interventions that engage families in supporting their children's learning at home are linked to higher student achievement. Miedel et al. (1999) longitudinal study of 704 low income parents of eighth graders and their involvement showed a long-term relationship between parent involvement and student achievement. In the study, participation in five parent activities was associated with a three-month increase in kindergarten reading achievement and a seven-month increase in eight grade reading achievement. The three implications of their work are :

1. Parent involvement is an important component of successful early intervention and should be emphasized in both new and established programmes

2. Implementing early parent involvement programmes can promote future family-school relations and a successful transition to first grade
3. Parent-involvement programmes can be a protective factor in overcoming risk conditions such as poverty, which lead to low achievement

The most effective forms of parent involvement are those which engage parents in working directly with their children on learning activities in the home. This conclusion is supported by high quality studies using contemporary techniques of data analysis from large data sets that have safely established that parental involvement at home manifested in the form of parent-child discussions can have a significant positive effect on children's achievement (Desforges and Abouchaar, 2003). Some of these studies include those conducted by Sacker et al (2002) on the National Child Development Study in England and Sui-Chu and Willms, 1996) who based their study on the US National Educational Longitudinal Study (NELS:88). These studies reveal that a great deal of variation in students' achievement is outside of the schools' influence such as that due to social class and parental involvement. However, unlike social class, parental involvement is open to the educative impact of schools. According to Sui-Chu and Willms, parental involvement made a significant and unique contribution to explaining the variation in children's academic achievement over and above the effects associated with family background. Sui-Chu and Willms, 1996, p. 138).

In the study of 24,600 8th grade students in the US, Sui-Chu and Williams (1996) concluded that "parental involvement in the form of home discussion made a significant contribution to explaining the variation in children's academic achievement over and above the effects associated with family background". (p.138). Studies cited in Desforges (2003) "showed that parental involvement in the form of 'at home' interest support is a major force in shaping pupils' educational outcomes." (p.22)

Promising outcomes have been documented in both mathematics and literacy when children's parents/families are involved in the educational process. Several studies have documented the significant impact of parent/family involvement on student achievement in literacy (Hara and Burke, 1998; Quigley, 2000) and mathematics (Balli, Demo, and Wedman, 1998; Epstein, 2001). These interventions ranged from teachers' notes, and formal training offered to parents on how to implement the programme at home and work effectively with their children.

These studies support the importance for schools to take a more proactive approach to initiate and develop programmes to assist parents in learning how to create a home environment that fosters learning and how to provide support and encouragement that are appropriate for their children's development level (Quigley, 2000).

Hence, if teachers would like to empower parents to help, they must demonstrate this with an active programme of parent involvement in learning activities at home. Workshops for parents on how to help their children at home or through school involvement can be organized and conducted e.g. by provide training for parents to be tutors of their children.

Studies on the Impact of Parent Education Programmes on Mathematical learning

Parent training programmes have shown to have a positive impact on parenting when programmes are specifically designed and managed to influence children's behaviours (Desforges & Abouchar 2003). A key question to ask, then could be : Can schools reach out to alter and develop spontaneous levels of parent involvement and thereby enhance pupil achievement?

A longitudinal school-level math achievement study conducted by Sheldon and Epstein (2001) has recommended that math homework involving families should be assigned and schools should offer lending libraries with math-related materials for families and students to use at home. It also suggests that elementary schools that involve families in students' math learning in a variety of ways are likely to produce higher student performance on standardized math tests.

Similar results for the impact of numeracy schemes were also found in a study by Brooks and Hutchinson (2000), which showed significant gains in literacy and numeracy were achieved, sustained and transferred to school. Communication between parents and children also improved markedly and parents reported being more able and confident in helping their child at home and communicating with the teacher in school.

Shumow's (1998) study on parental attunement to mathematics investigated change in parent scaffolding of children's problem solving as a result of participating in the parent education programme, which included receiving newsletters and accompanying homework and individualized conversation. The study suggested that education, experience and communication are required to promote parent understanding of what their children are learning, which is best attained through an effective partnership between home and school that entails sharing knowledge and experiences.

Workshops that inform parents about what their children are learning and how to help their children at home are also connected to gains in achievement. Shaver and Wallis (1998) studied the impact of school-based parent workshops that promoted five types of involvement (parenting, teacher-parent communication, parent involvement at school, parent involvement at home and programme decision making) on the achievement of 335 students in West Virginia and found that :

- Students with more highly involved parents were more likely to gain in both reading and math than children with less involved parents. This finding held across all income and education levels
- Younger students (grades 2-4) made greater gains than older students (grades 5-8)
- Students from lower income families made fewer gains than students from higher income families, no matter how involved their families. However, low income students with more involved parents made greater gains than low-income students with less involved parents
- A family's income level did not affect level of involvement. Low-income families were as likely to attend regularly as higher income families

The studies cited above suggest that parent involvement, no matter what the family background, is a dynamic force influencing students' academic success. They also "help to dispel the myth that poorer parents are less willing (and unable) to involve themselves in their children's education" (p.95)

Although it has been shown that direct parent instruction of their children at home positively affects school achievement, parents need specific information on how to help and what to do. (Cotten, K. & Savard, 1982). Cotton and Savard reviewed 18 studies on the effects of parent involvement in instruction on the achievement, attitudes, and behaviour of elementary and secondary students and found such involvement beneficial, especially when parents receive orientation and training for helping their children. Home learning activities were noted to have helped students who needed help the most. (Harris, Louis, et al 1987)

Research has shown that helping parents to teach children mathematics is important in the preschool years if we expect children to succeed in mathematics and school in the later years. Starkey and Klein's (2000) experimental study of a four-month programme that engaged 30 families to develop math skills in Head Start (pre K) children and another 30 families were assigned to two control groups. The study involved staff giving classes for mothers and their children and loaned activity kits for use at home, and examined how low income parents could contribute to their children's math readiness when provided with training and activities to work with the children. The study showed that the two key factors in the programme's success were the work of parent liaisons and the provisions of math kits to use at home. Over the pre K year, the intervention to improve children's informal mathematical knowledge made 'extensive developmental change' but the comparison children's did not. Hence, an important step toward achieving readiness for school is to provide parents with the tools they need to support their children's informal mathematics development.

The Mathematica Policy research and the Centre for Children and families at Columbia University (2001) examined the impact of the Early Head Start programme on 3,000 children and their families. The Early Head Start programme was designed to prepare low-income preschoolers for school and includes early education, parenting education, comprehensive health and mental health services, nutrition education and family support services. The experimental study found that the home environments of Early Head Start children were more likely to support cognitive development, language and literacy, based on researchers' observations, than control homes.

Similar findings were found in an experimental study conducted by Kagitcibasi et al.(2001) in Turkey that involved children who were randomly assigned to the HIPPY programme (Home Instruction Programme for Preschool Youngsters). In this programme, mothers from three different settings (home care provided by mothers with no support, childcare without education and educational nursery schools) were provided with training, home visits and discussion groups. In the short term, children in both HIPPY and nursery school settings made greater progress than children in the other two groups. Seven years after completing the programmes, children showed greater gains than children in the other groups, earning higher scores in reading and math and social development. Home-based training of mothers and the educational preschool both had positive effects on children's cognitive development and grades in language and mathematics. In addition, there were positive changes in mothers' expectations of children and in their interaction in the home. Although such a finding might not be totally relevant to the Singapore context, the finding does suggest that there are strong links between home-based training of mothers and children's gains in math, reading and social development

Conceptual Framework and Theory

This study draws on the following three models and theories :
Firstly, Epstein's (1987) School, Family and Community partnerships model of overlapping family and school spheres is based on a theory of family-school connections, which consists of overlapping or non-overlapping spheres representing family, school and community. The external model recognises that the three major contexts in which students learn and grow – the family, the school and the community – may be drawn together or pushed apart. The internal model which comprises the interaction of the three spheres of influence shows where and how complex and essential

interpersonal relations and patterns of influence occur between individuals at home, at school, and in the community.

This model is similar to the ecological model, which according to Urie Bronfenbrenner, espouses that each person is significantly affected by interactions among a number of overlapping ecosystems. At the centre of the model is the child, who is encircled by the Microsystems[7] that intimately and immediately shape the child's development. The primary microsystems for children include the family, peer group, classroom, neighbourhood. Interactions among the microsystems, as when parents and teachers coordinate their efforts to educate the child, take place through the mesosystem[8]. The richness of the mesosystem between home and school is measured by the number and quality of connections The stronger and more complementary the links between the settings, the more powerful the influence on a child's development.

The model of School, Family and Community partnerships locates the child at the centre. It posits that partnership activities can help to engage, guide, motivate students to produce their own successes.

After a child enters school, there will be some overlap of the two microsystems, namely the home and the school, at every grade level. The theory sets forth that the degree of overlaps of family and school organization and their goals and practices affects the social and psychological distance between family and school members,

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[7] Microsystems are the systems that intimately and immediately shape human development. The primary **microsystems** for children include the family, peer group, classroom, neighbourhood.

[8] The mesosystem consists of the setting(s) which directly contain the unit of analysis (i.e., father's community [his workplace and his involvement in the school board and local government]) (Bronfenbrenner, 1986). Interactions among the microsystems, as when parents and teachers coordinate their efforts to educate the child, take place through the mesosystem.

their patterns of communication and the results or outcomes of more or less interaction.

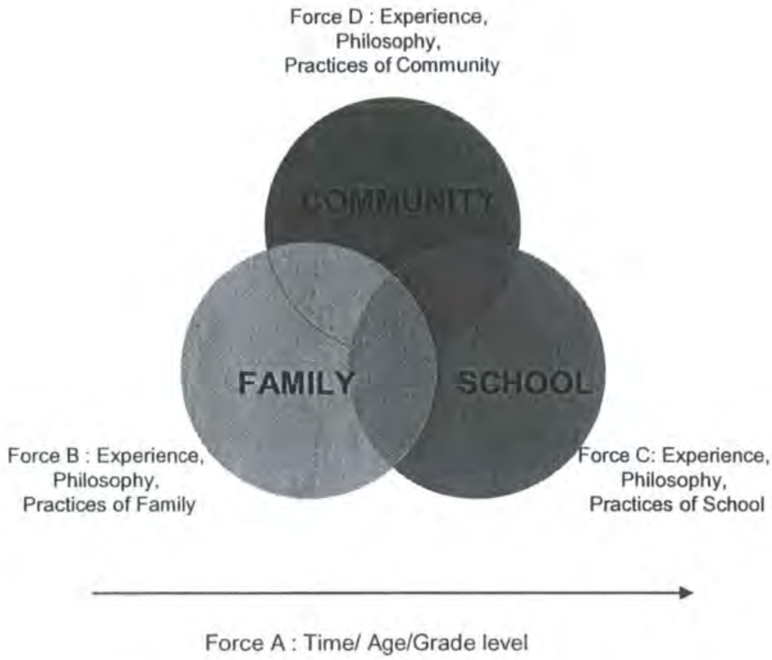

Figure 2-1 Overlapping Spheres of Influence of Family, School, and Community on Children's Learning (External Structure of Theoretical Model) [9]

Support for this theory is found in several empirical surveys and studies done with teachers, parents and students. The benefits or outcomes from greater overlap between the school and family happen when schools increase communications with families and their involvement. Families benefit from gaining more ideas about how to help their children at home and their knowledge about instructional programmes also improve. Students' test scores suggest that schools are more effective when families and school work together with the student on basic skills. Parents, students and teachers benefit most from practices that increase the overlap in school and family spheres of influence (Epstein 2001). According to Epstein, the degree of overlap is controlled by three factors : time, experience in families, and the experience in schools. The

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[9] Epstein, 2001, pp. 28

'maximum' overlap occurs when schools and families operate as true 'partners', with frequent cooperative efforts, clear and close communication between parents and teachers in a comprehensive programme of many types of parent involvement (Epstein, 1986).

Secondly, a widely recognized theory that helps to explain differences in the level of parent involvement is Bourdieu's (1977) theory of cultural capital. According to this theory, schools represent and reproduce middle or upper class values and forms of communications. Schools embody those values because teachers come from predominantly middle- upper class backgrounds and may have difficulty relating to parents who come from a different cultural frame of reference. That bias towards middle or upper class values puts working-class students and parents at a disadvantage because they must adapt to the dominant culture of the school to meet teachers' expectations, which result in processes that promote the involvement of middle- and upper class parents rather than those with lower SES. Hence, Bourdieu theorized that differences in the level of parent involvement can lead to the reproduction of status relations among groups (Feuerstein, 2000).

Laureau (1987) adapted Bourdieu's notion of cultural capital and related it more directly to parent involvement. Lareau stated that indicators of cultural capital include (a) amount of interaction a parent has with other parents (b) parents' understanding of school processes (c) amount of contact parents have with school personnel and (d) parents' communication skills.

Laureau found that teachers tended to give better evaluations of students if their parents were involved in the school. This suggests that cultural capital when translated into the form of parent involvement, can influence student achievement. A similar construct termed social capital was developed by Coleman (1998) which refers to social networks available to parents that enhance students' ability to benefit from educational opportunities. According to

Coleman, most schools have social structures that influence student achievement and some schools have stronger relationships with families than other schools do (i.e. possess more social capital) and are therefore able to promote higher levels of achievement.

Coleman suggested that factors that influence social capital include the schools' understanding of its obligations to students, parents' knowledge of the school system and the existence of norms that support high student achievement (Coleman, 1991). He therefore sees social networks as a resource available to all parents and students rather than a mechanism that regulates the distribution of student achievement.

Definition of Parent Involvement and Working Model for Study

The term 'parent involvement' is used broadly to include several different forms of participation in education and with the schools. This study draws on Epstein's typology of forms of parental involvement (Epstein, 1995) and focuses on Type 2 and 4 parent involvement (Communication and Learning at Home).

Epstein's Model of Parent Involvement : 6 major types of parent involvement

Type 1	Parenting	Help families establish home environment to support children as students
Type 2	Communicating	Design effective forms of school-to-home and home-to-school communication about school programmes and their children's progress
Type 3	Volunteering	Recruit and organize parent help and support
Type 4	Learning at Home	Provide information and ideas to families about how to help students at home with homework and other curriculum-related activities, decisions and planning
Type 5	Decision making	Include parents in school decisions, developing parent leaders and representatives
Type 6	Collaborating with Community	Identify and integrate resources and services from the community to strengthen school programmes, family practices and student learning and development

The typology provides schools and researchers with a structure to help organize specific activities to involve parents in their children's education. As there are many possible activities for each type of involvement, schools must choose which partnership practices are likely to achieve specific goals and how to implement the selected activities effectively.

As communicating with families through newsletters and parent workshops are common parent involvement initiatives adopted by our schools, the investigator is keen to find out whether these types of involvement would have an impact on children's math learning and parents' efficacy in helping their children learn math.

Parent involvement at home has a more significant impact on children than parent involvement in school activities. What parents do in the home environment remains significantly more important to student outcomes than what parents do in the school setting (Christenson and Sheridan, 2001; Izzo, Weissberg, Kasprow, and Fendrich, 1999; Trusty, 1999).

Parental Role Construction and Beliefs in Involvement

The third conceptual model referred to in this study is Hoover-Dempsey's model of parent involvement. This model looks at the area of parental role construction and was formulated as a result of studies that were designed to enhance parents beliefs and self-efficacy (eg, Bandura, 1997; Goodnow, 1998; Fullan, 2001). Applied to parents' involvement in children's education, parental role construction appears to define the range of activities that parents believe important and necessary for their own engagement in their children's schooling (Hoover-Dempsey and Sandler,1997).

Parents appear to become involved in their children's homework because they believe their activities will make a positive difference for the child (Bandura, 1997, Hoover-Dempsey and Sandler (1997). Self-efficacy theory suggests that parents' behavioural choices are guided in part by the outcomes they expect to follow their actions; the stronger the perceived self-efficacy for a task (e.g. helping with homework), the higher the goals are likely to be set and the greater the persistence they are likely to exhibit in reaching those goals (Bandura, 1997). Consistent with these suggestions, parents have reported reasonable confidence in their ability to help with homework; their confidence, in turn, has been associated with involvement (e.g. Ames, 1993; Balli, Demo and Wedman, 1998). Parent involvement processes that influence student outcomes include modelling, reinforcement and instruction (Figure 2-2). These operating mechanisms have been positively linked to student achievement and to student attributes related to achievement e.g. attitudes toward homework, perceptions of personal competence, self-regulation (Hoover-Dempsey, Battiato, Walker, Reed, DeJong and Jones, 2001). Parents appear to involve themselves in their children's homework for three major reasons : they believe that they should be involved, they believe that their involvement will make a positive difference and they perceive invitations to involvement (Hoover-Dempsey and Sandler, 1995, 1997).

Additionally, a sense of personal self-efficacy (the degree to which one feels able to make a difference), in turn depends on a number of related beliefs, attitudes and skills. Parents' beliefs interact with a sense of personal competence – if they have the resources, they will get involved to the degree that they feel they have the capacity to make a difference for their child (Bandura, 1997, Hoover-Dempsey & Sandler, 1997). Parents who hold positive beliefs about their efficacy to influence their children's education seem more likely to be involved. Shumow and Lomax (2001) examined parents' feelings of success in guiding their children. Parents have a high sense of efficacy when they believe that they can :

- Help their children do well in school, be happy and be safe
- Have a positive impact such as improving quality of school

The higher the parents' sense of self efficacy, the more closely they monitored their children and the more they were involved with school. In terms of student outcomes, they found that the higher the parents' feelings of efficacy, the more their children reported doing better in school.

This study aims to add to the existing literature of parent self efficacy studies and to find out if school communication and parent education can help to increase parental self efficacy, and if this would have an impact on children's mathematical development. Figure 2-2 summarises Hoover and Dempsey's model of parent involvement (1997).

Figure 2-2 The Hoover-Dempsey & Sandler (1995,1997) Model of Parent Involvement[10]

LEVEL 5: Child/Student Outcomes	
Skills and Knowledge	Efficacy for Doing Well in School

↑

LEVEL 4: Tempering/Mediating Variables	
Parents' Use of Developmentally Appropriate Involvement Strategies	Fit between Parents' Involvement Actions & School Expectations

↑

LEVEL 3: Mechanisms through which Parent Involvement Influences Child/Student Outcomes			
Modeling	Reinforcement	Instruction	
		Close-Ended	Open-Ended

↑

LEVEL 2: Parents' Choice of Involvement Forms Influenced by:				
Specific Domains of Parents' Skills & Knowledge	Mix of Demands on Total Time & Energy from:		Specific Invitations and Demands for Involvement from:	
	Other Family Demands	Employment Demands	Child(ren)	School/Teacher(s)

↑

LEVEL 1: Parental Involvement Decision (The Parent's Positive Decision to Become Involved) Influenced by:			
Parent's Construction of the Parental Role	Parent's Sense of Efficacy for Helping Child(ren) Succeed in School	General Opportunities and Demands for Parental Involvement Presented by:	
		The Parent's Child(ren)	Child(ren)'s School(s)

[10] Reference: Hoover-Dempsey, K.V., & Sandler, H.M. (1997). Why do parents become involved in their children's education? *Review of Educational Research*, 67, 3-42.

To show the various parent factors of this study are interrelated, the following model Fig 2-3 is proposed. In this model, it is suggested that through parent workshops and newsletters, parent confidence or self efficacy can be increased through acquiring new knowledge and skills on how to help their child learn at home. This in turn, would influence the way parents encourage and become involved in their children's learning at home through direct instruction.

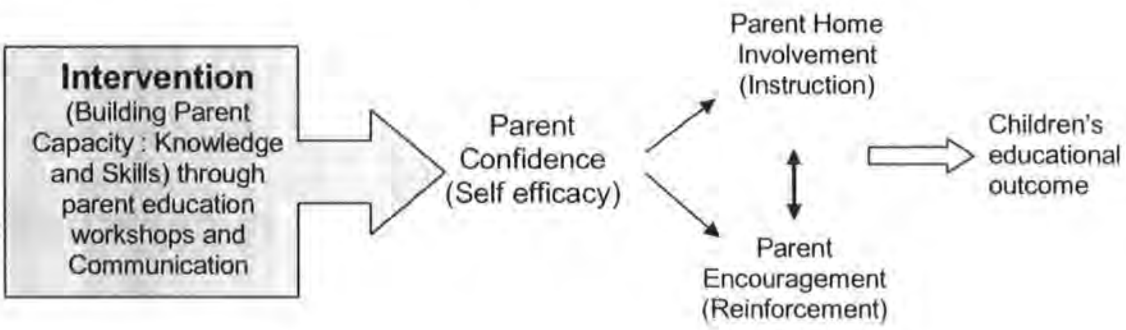

Figure 2-3 Suggested model of Influence

The intervention (workshops and newsletters or a combination of both) serves as 'tempering variables' (Figure 2-2) to help parents develop a positive influence on children's educational outcomes by enabling them to make use of developmentally appropriate involvement strategies and activities to help their children learn math at home. Hoover-Dempsey and Sandler (1995) suggested that parents who are able to choose or conduct activities and strategies that are developmentally appropriate are more likely to have the potential for positive impact on educational outcomes. Developmental appropriateness is a critical criterion because the parent's activity and strategy choices must be perceived by the child as positive if those activities are to exert positive influence on learning outcomes. The importance of this 'appropriateness' has also been underscored by studies that have reviewed the benefits of appropriate parent understandings of children's abilities and the importance of parents' abilities to act in supportive ways when helping children (Alexander and Entwisle, 1988; Miller, 1988).

Hence,, parents' choice of involvement forms and strategies need to be informed and be developmentally appropriate for the child if they are to have a maximum potential for positive impact.

Rationale for Choosing the Two Types of Parent Involvement for this Study

Based on the literature and theoretical frameworks outlined in this chapter, there are many reasons to believe that the earlier parents have the opportunities and support to be involved in their children's learning, the stronger their support for their children can be. Also, by involving parents in the educational process, educators acknowledge that parents have a great influence on their children's attitudes toward mathematics. Parents also have unique opportunities to relate problem-solving lessons to real-life situations at home. (O'Connell,1992, Arithmetic teacher).

Parental Capacity Building

This section of the literature review will focus on research that support the benefits of family involvement and the importance of building parental capacity to support their children's learning and educational progress, which in turn will help children do well in school. A research based model of effective parental involvement in schooling is presented in Figure 2-4.

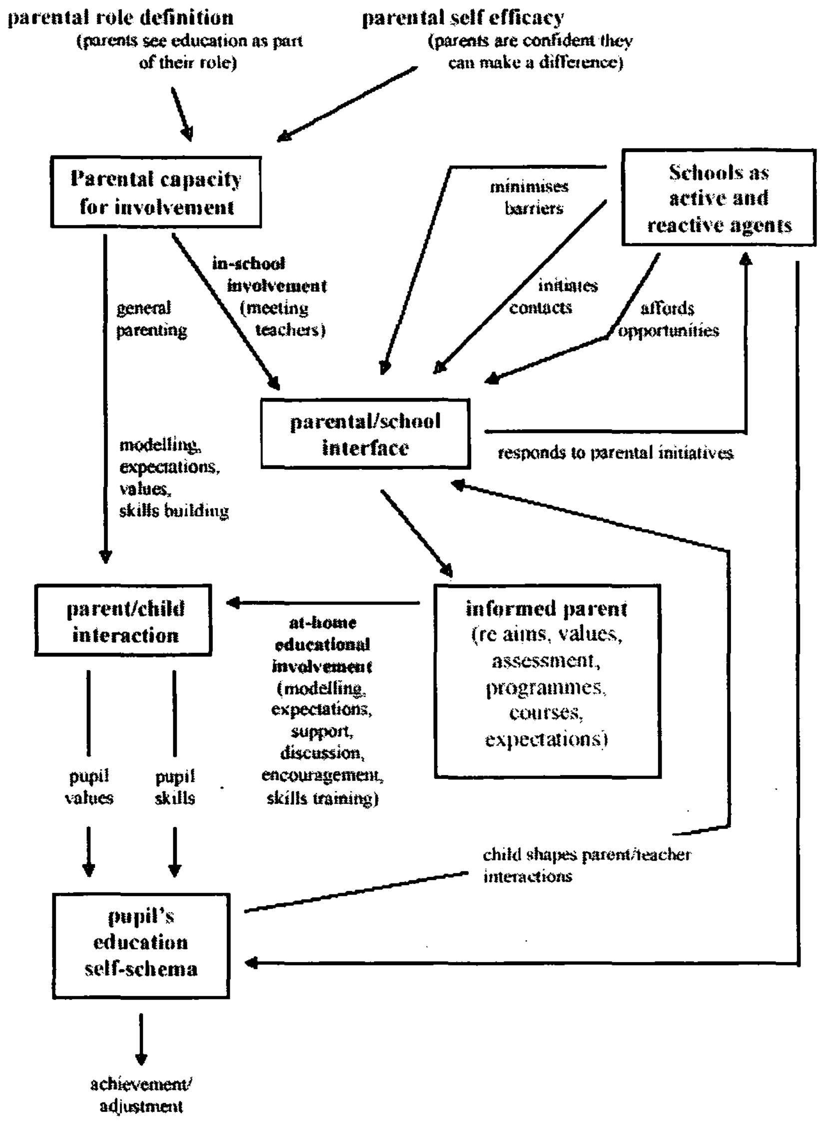

Figure 2-4 A research base model of effective parental involvement in schooling

A longitudinal school-level math achievement study found that some activities for family involvement in mathematical learning at home and at school predicted higher student performance on standardized math tests. (Sheldon and Epstein, 2001). Practices that increased teacher-parent communications about math and the involvement of families in math activities at school were found to be related to gains in the students' math proficiency. The authors also recommended that math homework involving families should be assigned and schools should offer lending libraries with math-related materials for families and students to use at home. Hence, it is important that schools communicate with parents about how to contact the maths teacher, conduct workshops on math skills and school expectations and invite parents to assemblies to celebrate math achievements.

Izzo et al's (1999) 3-year longitudinal study of 1,205 elementary school children from grades K-3 showed that engaging in educational activities at home had the strongest effect on student achievement. Parents' Home activities were related to the widest range of gains on math and reading tests, compared with the other forms of parent involvement. This research supports the notion that 'schools can improve children's performance by increasing parents' ability in terms of their knowledge and skills to support (their children's) learning at home' (p. 835). Hence, beginning parent involvement activities during early childhood can provide a strong foundation for family-school relations that can ensure successful transitions to first grade.

In studying interactive homework with math, researchers at the Centre of School, Family and Community partnerships at the John Hopkins University, Baltimore, found that the common problems in teachers involving parents with math homework were :

- Parents did not know how maths was taught in school
- Parents worried they may confuse their children about math if they got involved
- Children argued "you don't do it like my teacher does it."

Overall, the studies suggested that the use of homework that requires parent – child interactions can create a line of communication between parents and teachers, increase family involvement, and help improve student achievement.

Sanchez and Baquedano (1993) showed that children whose parents met with a math teacher and a counsellor to discuss ways to help at home, gained more in math than did students whose families did not receive training in such meetings. Similarly, students whose parents attended training and information workshops made greater gains in mathematics achievement than did students whose parents did not attend the workshops (Shaver & Wallis, 1998). Both studies suggest the importance of providing families support in their efforts to help their children succeed in math.

Teachers also have different ways of sharing their ideas about mathematics with parents and to give them insights into how mathematics is best taught and learned. Two primary avenues, newsletters and parent education workshops will be implemented and evaluated in this study.

Newsletters provide a way for sharing ideas and information and activities, on various class subjects. It can give suggestions for enrichment and extension at home. For instance, the teacher may suggest some activities that parents can carry out at home such as patterning, simple addition, graphing. A newsletter can also help to relate the key learning activities and events that have taken place in the classroom or school. That way, parents can be connected and informed of what their children are learning in school and how they can help reinforce some of these concepts and lessons at home.

Parent Education workshops or meetings provide yet another avenue for parents to be involved. Teachers can share and put out activities that are a regular part of the mathematics programme. They can talk about each activity and what children learn from using the material and point out what similar activities parents might use at home. Work can be sent home that will model the kind of teaching and learning that teachers would like parents and children to pursue.

The teaching of mathematical skills in the context of the child's own play activities, often referred to as incidental learning, is also an appropriate approach to teaching children mathematical concepts, since children need concrete materials and developmentally appropriate activities to help them create (construct) new mathematical knowledge by reflecting on their physical and mental actions. As suggested by Aubrey et al. (2003), who investigated early mathematical development in the home of nine young children, "fostering a positive disposition to learning mathematics where there is an opportunity for ideas to be tested out and mistakes to be made" is an important process of mathematical learning.

Hence, parents should be aware of mathematical opportunities that arise daily, such as setting the table for dinner, sorting the laundry, making a grocery list etc. Parents can also engage their children in 'mathematical talk' – discussion about numbers, shapes, size, patterns, relationships, estimates, operations.

Learning reflects a social process in which children engage in conversation and discussion with themselves as well as with others (parents, teachers) as they develop intellectually (Bruner, 1987). This principle suggests that children should be involved not only in manipulating materials, discovering patterns, problem-solving but also in sharing their observations and describing their relationships.

Suydam and Higgins (1977) suggested that manipulatives were particularly useful in helping children move from the concrete to the abstract level. Long term use of concrete materials was positively related to increases in student math achievement and improved attitudes towards mathematics. The study reviewed activity based learning in mathematics in kindergarten through grade 8 and concluded that using manipulative materials produced greater achievement gains than not using them. Hence, teaching math by making connections with the children's own experiences helps them to make sense of mathematics.

Parents can also read to their children and borrow math concept books to share with their children. Good concept books with interesting formats and size help to communicate excitement in exploring mathematical ideas. These books can also enrich learning as mathematics and language skills develop together as children listen, read, write and talk about mathematical ideas. These books can also be used for teaching reading and make a reading link between using concrete manipulatives and doing abstract paper-pencil activities (Gailey, 1993, Arithmetic Teacher).

As opportunities for mathematical experiences are all around, parents can be encouraged to supply materials for interesting and challenging activities that both parents and children can share and enjoy. It is suggested that the goals of mathematics at home are to help children develop a mathematical curiosity, and enthusiasm for solving mathematical problems. Many parents have the opportunity and the willingness to extend the learning that takes place in school, and with some help from teachers, they can do it. (Flexer and Topping, 1988, Arithmetic Teacher)

The Family Math Programme

Parental involvement in maths in North America was documented in a controlled evaluation of two successive years of a series of 'Family Math' programmes. Experimental children with prior Family Math experience showed higher gains on standardized mathematics performance measures than other groups, but only two of the analyses showed statistical significance (Topping, 1998).

The intervention programme selected for this study is closely modelled on the Family Math programme which originated at the University of California, Berkeley in 1983 and the Paired Maths project developed by Keith Topping and Judith Bamford (1998) in the UK.

Family Math believes that parents can help to teach students at home, and one way to harness this resource is to involve parents in playing mathematical games with their children. Family Math aims to give parents and children the opportunity to develop hands-on understanding of mathematics. It helps parents to become more involved in their children's mathematics education and children to gain confidence in their ability to learn mathematics.

Family Math programmes are based on some key beliefs that (Schwartz, 1999) :

- Children and parents should work on mathematics together
- All children, regardless of sex, cultural background or socioeconomic status can learn mathematics.
- Students are more apt to learn when the math is 'real' : when the curriculum and activities are exciting, meaningful, based on personal experiences and relevant to their lives
- Math tasks are an integral part of daily life, and families can learn math together as they engage in their usual activities
- Materials commonly found around the house can be used to make math games

The goal of Family Math is to get families talking together about mathematical ideas and doing activities that embrace topics including patterns and relationships, geometry and spatial reasoning, measurement and arithmetic. Just as children need experiences with language and reading outside school to become good readers, they need experiences with mathematics outside school to develop understanding of concepts that will allow them to grasp and use the subject (Stenmark et al. 1986, chap 24). Hence, to help parents become involved in their children's mathematical learning, Family Math emphasises the importance of giving opportunities to families to think about the following issues :

- The importance of being role models for their children
- How to become positively involved in their children's mathematics education
- The instructional approaches and content reform mathematics that are different from what they experienced
- That learning can be enjoyable and exciting

During a typical Family Math session, parents and their children learn mathematics activities together that reinforce the school mathematics curriculum. The activities use low cost materials and are designed to be repeated at home; and instructions and materials are furnished for the families to use at home. Typically, these sessions would include time for group sessions that allow teachers to provide support and observe how families learn. They also allow families access to resources not present at home. The other feature of the Family Math programme is the homework that parents get to take home to practice with their children. Such homework takes the form of math packs comprising learning materials, activities and games, and a mechanism for tracking loan and progress, similar to the developmentally appropriate, hands-on learning experiences used in the classroom.

Gaps in the Research

The 'first wave' of PI research has produced considerable descriptive information , with a predominant use of survey methods to gather data and information on the importance and effects of parent involvement.

Out of Baker and Soden's (1998) review of 145 empirical studies, 37 described the benefits of parent involvement for parents and 108 examined the link between parent involvement and student achievement. The authors critiqued that many parent involvement research to date had methodological flaws, which results in a loss of confidence in these findings. Some of these weaknesses include :

1. Use of non-experimental designs - most methodologies are surveys i.e. descriptive rather than explanatory, which do not explain relationships
2. Non-objective Measures of Parent Involvement such as self-report measures which results in lack of objective data and failure to capture the dynamic nature of parentsal involvement due to close ended surveys
3. Lack of isolation of the specific effects of parent involvement.
4. Some studies failed to examine relationships among parent involvement, student achievement and gender
5. Some studies failed *to* take into account the complex and transactional nature of interrelationships between parent involvement and its outcomes

The few studies that met the standards for experimental studies included Head Start Family Math, the HIPPY programme (Mathematica et al, Starkey and Klein, and Baker et al) In order to increase the accuracy and usefulness of parent involvement research, Baker and Soden recommends the use of experimental procedures to overcome threats to internal validity.

RESEARCH QUESTIONS

The literature surveyed in this chapter clearly points to the potential benefits of parent involvement on children's learning and school achievement. In particular, evidence from the empirical studies conducted in different countries show positive evidence for parent involvement on children's math learning.

In the local Singapore context, the importance of parent involvement has also been recognized by both educators and politicians as an important strategy for schools to help children perform better in school, and strong support from the local government in Singapore to encourage schools to engage parents in their children's learning have been documented. However, since there are many possible activities for the different types of parent involvement that schools can adopt, it would be important for schools to choose partnership practices that are most likely to produce the outcomes that can help to enhance children's learning. Since there is a lack of empirical evidence in the Singapore context with regard to the effectiveness of the types of parent involvement in helping parents support their children's learning at home, the rationale for this study is justifiable.

Two of the most common types of parent involvement adopted in preschools and primary schools include sending newsletters as a means of sharing information and updates on the school's developments etc as well as conducting parent education workshops. Hence, it would be relevant to find out if either one or both these types of parent involvement had a greater impact on children's learning and building parental capacity in terms of parents' self efficacy in helping their children learn at home. As the literature reviewed in this section indicate that these two types of involvement can have an impact on the children's learning outcomes, it would be appropriate to see if the same applies to the local context in the Singapore preschool/ daycare setting.

This study attempts to find out which strategies are effective in helping parents to support children's learning at home i.e. Parent education workshops and communication through newsletters or a combination of both. It aims to address the following questions :

Does a single type (parent workshop or communication) of school initiated involvement or a combination of types of school initiated Involvement (workshop and communication through newsletters) help to improve :

1. children's math outcomes

2. parent self efficacy and confidence in helping their child's mathematics learning at home
3. parent encouragement
4. parent home involvement

RESEARCH HYPOTHESES

For each of the treatment conditions, children and parents were expected to demonstrate some gains in the scores of the above variables.

Children Math Achievement

Children in the treatment groups were expected to perform better than those in the control group. The hypotheses were as follows :

1. Greater improvement in math gains for the treatment groups as compared to the control group.
2. The largest improvement in math gain to be seen in the workshop*communication group compared to the other two experimental treatments and control group.

The following null hypotheses were constructed to be tested in this study using two dependent variables :

The first two null hypotheses test for the main effects of the two factors and the null hypothesis for main effects is that there are no differences among the levels of the factors (i.e. $H_0 : \mu_{\text{No Communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$) and that these factors will have no effect on the children's math outcome

The third null hypothesis tests the effects of the combination of the two factors together. The null hypothesis for the combined factors is that there is no difference between the combined factors (i.e. $H_0 : \mu_{\text{No Workshop*Communication}} = \mu_{\text{Workshop*Communication}}$), and the combination of the two factors will have no effect on the children's math outcome.

Parent Dependent Variables

Parents in the treatment groups were expected to perform better than those in the control group. The hypotheses were as follows :

1. Greater improvement in all three parent variables for the treatment groups as compared to the control group.
2. The largest improvement (in the parent variables : Parent Confidence / Self efficacy, Parent Encouragement and Parent Home Involvement) to be seen in the workshop*communication group compared to the other two experimental treatments and control group.

The following Null hypotheses were constructed to be tested in this study using two dependent variables :

The first two hypotheses test for the main effects of the two factors and the null hypothesis for main effects is that there are no differences among the levels of the factors (i.e. $H_0 : \mu_{\text{No Communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$) and that these factors will have no effect on :

1. Parent Confidence / Self efficacy
2. Parent Encouragement
3. Parent Home Involvement

The third hypothesis test is the test of combined factors which examines the effects of the combination of the two factors together. The null hypothesis for the combined factors is that there is no difference between the factors (i.e. $H_0 : \mu_{\text{No Workshop*Communication}} = \mu_{\text{Workshop*Communication}}$), and the combination of the two factors will have no effect on :

1. Parents Confidence / Self efficacy
2. Parent Encouragement
3. Parent Home Involvement

Conclusion

This chapter sets out to review the relevant literature and past studies conducted on the importance and impact of parent involvement on children's academic outcomes. The literature review supports that it is parent involvement in learning activities in the home that is most closely associated with better cognitive attainment in the early years, especially when both parents and educators negotiate a continuity of experience for the children.

A review of the literature presented many different ways of getting parents involved in their children's education. Of these, the use of communication through newsletters and ideas from the Family Math programme were selected and adapted for the parent education workshop as a key intervention in this study.

The two types of parent involvement, parent teaching at home and communication (newsletters) were also selected from Epstein's typology as these are deemed to be the 2 types of school-initiated parent involvement approaches that primary schools and some preschool centres are most likely to adopt. The effects of these two types of involvement on children's math learning and parental self efficacy and role construction will be studied.

Since there are two key factors (workshop and communication through newsletters) that are of interest to this study, a 2x2 factorial experimental design was selected for this study.

A review of the weaknesses in some of the research designs of past studies were also briefly discussed, showing a lack of experimental designs being used. Hence,, this study aims to address some of these design limitations by using an experimental procedure to :

1. Overcome threats of internal validity by adopting a pre-test, post test design, randomly assigning classes to be studied to

either treatment of a control group, to ensure that the experimental groups are probabilistically equivalent.

2. Adopt interventions that are consistently planned and carried out
3. Use an objective assessment for children's math achievement
4. Isolate effects of the types of interventions on parent involvement i.e. workshop and communication

The next chapter will describe the methodology, research design and interventions used in this study.

3. METHODOLOGY : RESEARCH DESIGN AND INTERVENTIONS

Research Design

This chapter describes and presents the methods, interventions, instruments, and operationalisation of key concepts, used to address the research questions listed at the end of chapter 2. It will be divided into 6 sub-sections : (1) Research Design used in the study (2) Operationalisation of key concepts and description of the instruments used (3) Sample and participants (4) Data collection (5) the Programme Intervention Procedures and materials will be presented at length on the different experimental treatments, namely, the family math workshops and math activity kits and family math newsletters and finally, (6) the limitations of this study will be presented.

Fitness of Research Methodology

Since the purpose of the study is to find out the causal link of two independent factors, (a) parent workshops (b) newsletters and (c) parent workshops and newsletters and their effects on children's mathematical learning and parental efficacy and involvement at home, the 2 x 2 factorial experimental design was chosen for this study. By adopting this design, both the main effects of each of each independent factor as well as a combination of the 2 factors can be studied. The 2x2 factorial design is also preferred to a simple experiment design, since in the real world, we are exposed to a variety of variables. For instance, both newsletters and parent workshops are commonly used as school initiated parent involvement strategies and because there is a chance that these variables interact, a factorial design could help capture some of this complexity.

The dependent variables in this study, children's change in math and parent efficacy and parental involvement at home will be measured quantitatively using a criterion-referenced test and a parent survey instrument respectively. These measures, taken over a span of 12 weeks, include a pre and post measure. Hence, the data analysis will adopt a quantitative approach.

The participating classes in the study were randomly assigned to the experimental and control groups to ensure that they are probabilistically equal.

The levels of independent variables are presented as follows :

Factor B (Workshop)	Factor A (Communication)	
	Present	Absent
Present	Group 4	Group 2
Absent	Group 3	Group 1

The following randomised pretest posttest control experimental design is proposed:

R	$O_{1,2}$	X1	$O_{1,2}$
R	$O_{1,2}$	X2	$O_{1,2}$
R	$O_{1,2}$	X3	$O_{1,2}$
R	$O_{1,2}$	X4	$O_{1,2}$

Dependent Variables :

O_1 = children Math scores

O_2 = Parent involvement scale

X_1 = Control Group (no Workshop and no Communication)

X_2 = Workshop only (with math activity kits)

X_3 = Communication only (via newsletters)

X_4 = Newsletters and parent Education workshops (newsletters and math activity kits)

The following steps were taken to ensure a random allocation of groupings :

1. A total of 21 classes were selected for the study. These classes were selected on the basis that each class would have a minimum of 12 children enrolled.
2. To ensure that the experimental groups had a similar mix of professionally qualified teachers, the 21 classes were assigned into four groups to balance the distribution of the teachers, based on their professional qualifications (i.e. Diploma or Certificate trained). These classes were then randomly assigned to the three treatment and control groups.
3. One of the groups was made up of 6 classes to make it more comparable in terms of the total number of children. It turned out that the group with 6 classes was assigned as the control group.

Social Interaction Threats

Participants including teachers, children and parents of the study were not told which groups they were assigned to. Since each centre had only one condition occurring, meetings with either the parents or teachers of the different centres were conducted at the respective centres to avoid the situation giving rise to diffusion or imitation of treatments and compensatory rivalry by respondents (Cook and Campbell 1979). The groups receiving the programme will therefore have little opportunity of communicating with the other groups since they were 'blind' to the other centres that are involved in the study.

Internal Validity Issues

Selection threat is addressed by a random assignment of the 21 intact K2 classes to the experiment and control groups. In so doing, we are able to assume that the groups have a form of equivalence i.e. they are "probabilistically" equal (Trochim, 2001).

The classes are taken from different child care centres and are therefore independent samples, at the class level. A comparison of the pre treatment group mean scores (math scores) among the selected groups will be made to see if these groups are similar in order to pre-empt any regression threats.

Operationalisation of Key Concepts and Measures used

The following variables and indices will be measured. Two main instruments were used in the data collection process.:

Children's Math Ability

In considering the selection for an appropriate assessment instrument, both a norm-referenced assessment (TEMA)[11] and a criterion-referenced assessment were considered for this study. However, given the limited manpower and the limited period of time to conduct the study, a criterion-referenced assessment was selected over a norm-referenced math assessment. As reported in the pilot trial of the TEMA (see Appendix I), due to the wide range of math skills covered in the instrument, it was unlikely to be sensitive to measuring slight improvements and small though important changes in understanding the math concepts that were the main focus of this study. Also, the pilot trial of TEMA required up to 60 minutes per individual child to administer and record, and the demand on manpower was far beyond the available time and resources set aside for this study. The pre-test alone would have taken up to 9 weeks just to complete administering the pre-tests to the 250 children, and without any additional manpower set aside for this purpose, it would have adversely affected the progress and timeline of the study.

Furthermore, it was deemed necessary that the pre and post test phases be completed for all the children within a reasonable short duration of about 3 weeks in order pre-empt any possible maturation

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[11] A description of this instrument together with a brief report of the piloting of TEMA is found in Appendix I

effects. The above reasons were the main justification for choosing a criterion-referenced assessment over a norm-reference assessment.

The practical limitations faced by the investigator made it necessary to find an alternative assessment mode to measure children's math ability that would meet the following criteria and could be administered under the following conditions:

1. Able to be administered the test in a small group setting within a 30 min time frame in one seating, to avoid test fatigue.
2. Items in the instrument are relevant and correspond with the content of math concepts that were being taught to the children and would be suited for use in the local context of this study

Criterion referenced assessment to measure children's math achievement

In view of the limitations (in terms of the lack of manpower to administer a 45 min test and the lack of appropriate matching items with the math concepts being taught to the children) with regard to the use of TEMA, a criterion-referenced achievement test in the form of a criterion-referenced test was designed instead to determine whether or not a child has acquired certain specific math concepts. The advantage of this type of test is that it can be designed to assess the appropriate math concepts that were taught, hence, increasing the content validity of the instrument.

Since the curriculum and math concepts for 6 year olds varies from country to country, the criterion-referenced assessment was deemed more appropriate, as it was designed to suit the local context and this study, compared to criterion-referenced tests developed in another country.

The first self-constructed criterion-referenced assessment was piloted and administered to four 6 year olds in a group setting which took less than 30 minutes to administer and complete. It comprised 33 items : 6 counting (up to 10), 6 ordering of numbers (e.g. What comes before '7'), 6 questions on more – less, 4 items on number line where child fills in the missing numbers, 3 items on ordinal numbers and 8 items of simple addition (up to 5) (Appendix I, p. 332).

Based on the high scores attained on this pilot, the items were found to be too easy for the age group, hence, the following changes were made to the test :

1. Replace some counting items to include counting of objects up to 20
2. Include 2 items on graphing
3. Include number lines with more blanks and in reverse order
4. Include simple addition and subtraction (up to 10) with part-whole concept
5. Include 2-3 items on patterning
6. Include some word-picture problem sums on simple addition and subtraction (symbolic additive – number bonds)

The revised assessment included the above mentioned items. Some of the TEMA items were also adapted and included in the paper-pencil task. The investigator took into consideration the practicality and suitability of the two assessment modes and adopted the criterion-referenced assessment instead as it was better suited and deemed more appropriate for such a large sample. Since it could be administered in a small group setting (of 5 – 8 children at a time and could be completed in about 30 minutes per group), it is also more practicable and feasible given the constraints of limited manpower (there was no budget to hire research assistants) faced by the investigator.

The revised criterion-referenced paper and pencil focused on assessing the following children's math concepts and skills :

1. More, less same – comparing groups of objects
2. Counting, numeral writing, matching the numeral with a collection (of up to 10 objects)
3. Counting on and counting back – number line
4. Number bonds (combining sets of objects and counting up to 10)
5. Patterning – shapes – what comes next ?
6. Picture graphs – counting and comparing more, less
7. Ordinal numbers – 1^{st} – 10th

Similarly, the above concepts and skills were also aligned to the intervention i.e. the content covered in the math kits, parent workshops and newsletters were the same mathematical concepts included in the math assessment.

The pre and post test had 10 sub-sections comprising a total of 58 different items which when answered correctly, would be awarded 1 mark each. Hence, the highest mark that each child can score is 58 and the lowest, is 0.

The items found in the math assessment [12]are summarized as follows :

1. How many? – Children were asked to count the number of items in 6 sets and to write the number in the box . (1 mark per item x 6 = 6 marks)
2. What comes after? Children were asked to write the number that comes after a pair of numbers e.g. 17, 18, ___ (1 mark per item x 6 = 6 marks)
3. Write the missing numbers – children were asked to fill in the missing blanks with the correct numbers(1 mark per item x 10 = 10 marks)

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[12] Please refer to Appendix C1 and C2 for sample copies of the pre and post math assessment

4. Colour the object in the correct position – children were given instructions (written and verbal) to colour the stated n th item (1 mark x 4 = 4 marks)
5. More / Less – children were asked to circle the set that is greater (1 mark x 3 = 3 marks)
6. Picture graphs – children were asked to write the answers in the blanks based on the picture graph (1 mark x 4 = 4 marks)
7. Simple addition – children were asked to count and write the correct numbers in the blanks, given pictorial cues (1 mark x 8= 8 marks)
8. Patterning – children were asked to colour the shape (pattern) that comes next (1 mark x 3 = 3 marks)
9. Counting on (+1) and counting back (-1) – children were asked to count on and count back (1 mark x 6 = 6 marks)
10. Simple addition (word sums) – The word sums were read to the children after which they had to fill in the blanks with the correct numbers (2 marks x 4 = 8 marks)

Total 58 marks

Criterion referenced achievement tests are usually intended to determine whether a child has acquired a clearly specified set of skills measured in a specific way. Its advantage is that it can be designed to assess the programme /concepts that have actually been taught rather than what might have been taught. This way, it is said to have high ecological validity and is relevant for the purpose of this study (Topping, 1998). However, because of its content-specific nature and the fact that it was designed for a particular group, criterion-referenced tests are less likely to have high broad-spectrum reliability and validity as compared to norm-referenced tests.

A criterion-referenced test was preferred and selected over a norm-referenced test for this study, as the latter may not be sensitive enough to be used to determine individual progress in specific areas and within a short period of time, changes in math knowledge would not be easily detected by such instruments.

The initial math test was piloted and revised to ensure that the content would neither be too easy nor too challenging for the age group of the children selected for this study.[13] To ensure consistency in administering the assessments, the investigator undertook to conduct all the assessment for every child participating in the study. The paper and pencil assessments were printed and brought to the centres by the investigator to ensure that the teachers did not know what the children were being assessed on. For children who were unable to read the instructions, pictures and symbols were printed on each activity and the investigator read the instructions to the children – similar to a listening comprehension activity – and children responded by writing or circling their responses on paper. Efforts to monitor and dissuade children from 'helping' their friends by sharing their answers were made by arranging the seating between 2 children further apart and outlining some rules before the paper -pencil test was administered.

The total score of the assessment is expressed as the number of items answered correctly, the focus being 'what' the children were able to do in terms of standards of proficiency within the selected domains. Children's change math score (post – pre math) was a key dependent variable in this study.

Reliability Coefficient of the Pre and Post Math Assessment

The alpha coefficient for the math assessment (all items) based on the pre-test and post test, was 0.92 and 0.94 respectively. The coefficients for the different sub-sections of the pre and post math test are summarized in tables 3-1 and 3-2.

Table 3-1 Reliability Statistics for pre math test – Cronbach alpha

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[13] Please refer to Appendix I for a report on the piloting of the math criterion-referenced test

Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All items	.920	.931	57
Rational Counting [14]	.610	.606	5
Number sequencing	.958	.961	6
Missing Numbers	.919	.927	10
Sequencing	.861	.863	4
Greater /Lesser	.902	.902	3
Graphing	.395	.453	4
Addition	.870	.865	8
Patterns	.611	.610	3
Counting On /Back	.918	.917	6
Word Sums	.709	.708	8

Table 3-2 Reliability Statistics for post math test– Cronbach alpha

Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All items	.941	.936	58
Rational Counting	.646	.743	6
Number sequencing	.919	.923	6
Missing Numbers	.877	.875	10
Sequencing	.828	.830	4
Greater /Lesser	.566	.610	3
Graphing	.454	.504	4
Addition	.831	.831	8
Patterns	.649	.678	3
Counting On /Back	.951	.950	6
Word Sums	.808	.795	8

The Guttman split-half Coefficient for the pretest and post test was 0.59 and 0.79 respectively (Tables 3-3 and 3-4).

Table 3-3 Reliability Statistics (Pre test) – Split Half

[14] For this item, children were required to count and write the number of objects in each of the 6 squares. However, this component variable (RC4) had zero variance and was removed from the scale

Cronbach's Alpha	Part 1	Value	.913
		N of Items	28(a)
	Part 2	Value	.889
		N of Items	29(b)
	Total N of Items		57
Correlation Between Forms			.466
Spearman-Brown Coefficient	Equal Length		.635
	Unequal Length		.635
Guttman Split-Half Coefficient			.587

Table 3-4 Reliability Statistics (Post test) – Split Half

Cronbach's Alpha	Part 1	Value	.886
		N of Items	29(a)
	Part 2	Value	.916
		N of Items	29(b)
	Total N of Items		58
Correlation Between Forms			.707
Spearman-Brown Coefficient	Equal Length		.828
	Unequal Length		.828
Guttman Split-Half Coefficient			.789

Parent Involvement Scale :

The Parent Involvement questionnaire was adapted from the Hoover-Dempsey & Sandler Model of Parental Involvement scales to measure parent mechanisms of involvement[15]. It comprised a total of 43 Likert scale items and some demographic questions to help capture data on the participants. The questionnaire included 5 sub-scales adapted from the following authors and were further piloted and subsequently modified to suit the context of study and to address the research questions.

[15] Permission was sought and granted by the authors, Kathleen Hoover-Dempsey and Sandler on 225 February 2004 (Appendix B-1). Detailed scale descriptions can be obtained from the website http://www.vanderbilt.edu/Peabody/family-school/model.html

The following section summarises the five subscales and the modified subscale items used in this study. A more detailed report on these subscales following a factor analyses of these items will be presented in the Chapter 5.

The first version of the modified survey was piloted in 2 centres (that were not selected for the study) with 10 parents of children in the same age range selected for the study. Results of this pilot are reported in Appendix J.

Following the piloting of the instrument, the items in the original scales were further modified to suit the local context and age group of the children as well to the local parenting practices that were deemed relevant to this study.

For instance, changes made to the items were made to :

1. Improve the semantics by simplifying the sentences and making it more applicable to the local context and purpose of this study e.g. re-phrasing "I made sure that my child's homework got done" to " help my child with homework", and re-phrasing, "I know how to help my child do well in school" to "I have confidence in helping my child learn math"
2. Re-phrase certain items in the affirmative sense (e.g. I know, rather than I don't know) to avoid the need to use a reverse score
3. Eliminate irrelevant items like and "I took my child to the library, community events or similar places", which were not applicable to the context of this study

Scale 1: Parent Efficacy (Confidence) for Helping Children Succeed in School

The scale assesses parents' beliefs about their efficacy for helping their children succeed in school. Drawn from the literature on personal efficacy and teacher self-efficacy (Ashton, Webb & Doda, 1983; Bandura 1984, 1986), the scale was developed during a study of relationships among teacher efficacy, parent efficacy, and parent involvement in elementary schools (Hoover-Dempsey, Bassler & Brissie, 1992). It included 12 items and employed a 5-point Likert-type response scale. Administered to 390 public elementary students' parents, reported alpha reliability for the scale was .81.

Using a six-point Likert-type response scale (1 = Disagree very strongly 2 = Disagree ; 3 = Disagree just a little; 4 = Agree just a little; 5 = Agree; 6 = Agree very strongly), participants were asked to respond to the following prompt: "Please indicate how much you AGREE or DISAGREE with each of the following statements.. Please think about your child in this current school year as you consider each statement."

The twelve items of the original scale were revised to suit the purpose and context of this study e.g. for item 1, instead of using the general phrase like 'I know how to help my child do well in school' , this was replaced by 'I have confidence in helping my child learn math'. The other items were also changed to make the statements more age appropriate to the children involved in this study, and since they are preschoolers, the issue of grades and school performance were not relevant.

Original scale (11 items)	Modified scale (12 items) (Pconf) adapted for this study
1. I know how to help my child do well in school. 2. My child is so complex I never know if I'm getting through to him/her. (reverse score) 3. I don't know how to help my child make good grades in school. (reverse score) 4. A student's motivation to do well in school depends on the parents. 5. I feel successful about my efforts to help my child learn. 6. Other children have more influence on my child's grades than I do. (reverse score) 7. Most of a student's success in school depends on the classroom teacher, so I have only limited influence. (reverse score) 8. I don't know how to help my child learn. (reverse score) 9. If I try hard, I can get through to my child even when he or she has difficulty understanding something.	1. I have confidence in helping my child learn math 2. I am successful in helping my child learn. 3. I have a good understanding of the K2 maths curriculum 4. I know enough about the subjects of my child's homework to help him or her. 5. I am able to make use of everyday experiences (e.g. While at home or at the supermarket etc) to teach my child 6. I know how to explain things to my child about his or her homework. 7. I have enough time and energy to help my child with homework. 8. I have enough time and energy to communicate with my child's teacher. 9. I know how to help my child be ready for Primary One

10. I make a significant difference in my child's school performance. 11. Other children have more influence on my child's motivation to do well in school than I do. (reverse score) 12. My efforts to help my child learn are successful.	10. I can make a big difference in helping my child adjust to Primary One 11. I know where to find resources to support my child's learning 12. I know how to use everyday materials to help my child learn

Scale 2 : Parent-focused Role Construction – Parent Responsibility (Pres)

All belief items in the scale use a *disagree very strongly* to *agree very strongly* format:

Disagree very strongly = 1, disagree = 2, disagree just a little = 3, agree just a little = 4, agree =5, agree very strongly = 6 . Total subscale scores range from 6 to 56. Higher scores indicate a stronger parent-focused role construct.

The instructions for beliefs:

Parents have many different beliefs about their level of responsibility in their children's education. Please respond to the following statements by indicating the degree to which you believe you are responsible for the following:

Original 9 items	Modified 6 items (Pres) adapted for this study
Belief items: 1. It's my job to explain tough assignments to my child. 2. It's my job to make sure my child understands his or her assignments. 3. I make it my business to stay on top of things at school. 4. Behavior items: 5. I kept an eye on my child's progress 6. I made sure that my child's homework got done. 7. I helped my child study for tests or quizzes. 8. I talked to my child about what he or she is learning. 9. I took my child to the library, community events, or similar places.	1. ...make sure my child understands his /her homework 2. ...communicate with my child's teacher regularly. 3. ...help my child with homework. 4. .....set family rules about doing homework 5. .....explain things to my child about his or her homework. 6. ...talk with my child what he /she is learning at the centre

For this scale, some of the original items like items 3, 7, 9 were not relevant to the context and participants involved in this study and were therefore omitted. Also, some terms like 'assignments', were replaced with the term 'homework' instead as this was a more culturally appropriate term.

Scale 3 : Parent Self-Report of Parental Encouragement of Students (Penc)

The scale assesses parent self-reports of parental modeling of strategies for solving problems, self-regulating, and learning. This scale was adapted from Martinez-Pons (1996) and was used during a three-year, four-study project (Hoover-Dempsey & Sandler, 2001-2004) to test the Hoover-Dempsey Sandler model of the parent involvement process and is reported in Hoover-Dempsey et al. (2004).

Parents were asked to respond to the following prompt: 'Parents and families do many different things when they help their children with schoolwork. Please indicate how often the following have happened since the beginning of the school year on each item'.

Items in the original scale used a Never to Always response format: Never = 1, Seldom = 2, Sometimes = 3, Often = 4, Very Often=5, Always=6. For the purpose of this study, all items in the scale were changed to : 1 = never; 2 = 1 or 2 times; 3 = 4 or 5 times; 4 = once a week; 5 = a few times a week; 6 = daily)

Original 12 Items	Modified 5 items (Penc)[16] adapted for this study
We encourage this child ... 1. ... when he or she doesn't feel like doing schoolwork. 2. ... when he or she has trouble organizing schoolwork. 3. ... to try new ways to do schoolwork when he or she is having a hard time. 4. ... to be aware of how he or she is doing with schoolwork. 5. ... when he or she has trouble doing schoolwork. 6. ... to look for more information about school subjects. 7. ... to develop an interest in schoolwork. 8. ... to believe that he/she can do well in school. 9. ... to stick with problems until he/she solves it. 10. ... to believe that he/she can learn new things. 11. ... to ask other people for help when a problem is hard to solve. 12. ... to explain what he/she thinks to the teacher.	We encourage and help our child to .... 1. ... learn new things. 2. ...find new ways to do schoolwork when he or she gets stuck. 3. ...to stick with his or her homework until he or she finishes it. 4. ...make his or her homework fun. 5. ...how to find out more about things that interest him or her.

The original 12 items were considered to be too many and onerous, and hence, only 5 items were selected and modified e.g. 'Homework' replaced 'school work'/ 'problems' and item 4 'make his or her homework fun' was modified to 'develop an interest in schoolwork'.

Scale 4 : Parent Self Report of Parental Reinforcement of Students Preinf)

The scale assesses parent self reports of parental modeling of strategies for solving problems, self-regulating, and learning. This scale was adapted from Martinez-Pons (1996) and was used during a three-year research project (Hoover-Dempsey & Sandler, 2001-2004) to test the Hoover-Dempsey & Sandler model of the parent

[16] These items were selected based on the age-appropriateness and relevance to the local context

involvement process and is reported in Hoover-Dempsey et al. (2004).

Parents were asked to respond to the following prompt: 'Parents and families do many different things when they help their children with schoolwork. We would like to know how true the following things are for you and your family when you help your child with schoolwork. Please think about the current school year as you read and respond to each statement'.

A six-point, Likert-type scale (i.e., 1=Never, 2=Seldom, 3=Sometimes, 4=Often, 5= Very often 6=Always) was used.

Original – 13 Items	Modified items (Preinf)[17] – 3 items adapted for this study
We show this child we like it when he or she … 1. … wants to learn new things. 2. ... tries to learn as much as possible. 3. ... has a good attitude about doing his or her homework. 4. ... keeps working on homework even when he or she doesn't feel like it. 5. ... asks the teacher for help. 6. ... explains what he or she thinks to the teacher. 7. ... explains to us what he or she thinks about school. 8. ... works hard on homework. 9. ... understands how to solve problems. 10. ... sticks with a problem until he or she solves it. 11. ... organizes his or her schoolwork. 12. ... checks his or her work. 13. ... finds new ways to do schoolwork when he or she gets stuck.	1.…wants to learn new things. 2.…has a positive attitude about doing his or her homework. 3.…keeps working on homework even when he or she doesn't feel like it.

The 13 items in the original scale were considered to be too many and only three items 1,3 and 4 were selected based on the appropriateness and relevance to the context of this study and the age of the children involved in this study.

[17] Not all thirteen items in the original instrument were relevant or necessary, Hence, only three of the most appropriate were selected

- Parent Choice of Involvement Activities (Parent Involvement)

The scale assesses parents' choice of involvement form in children's education. The scale was adapted from work by Epstein and Salinas (1993) and Hoover-Dempsey, Walker, Jones & Reed (2002).

Participants were asked to respond to the following prompt: 'Parent and families do many different things when they are involved in their children's education. We would like to know how often you have done the following since the beginning of the school year for your K2 child.'

A six-point, Likert-type frequency scale (i.e., 1=Never, 2=1 or 2 times this year, 3= 4 or 5 times this year, 4=once a week, 5=A few times a week, 6=Daily) was used.

Original 10 Items	Modified items (Pinv) [18]- 8 items adapted for this study
1. Subscale: Child-Specific Involvement Some one in this family... 2. ...talks with this child about the school day. 3. ...supervises this child's homework. 4. ...helps this child study for tests. 5. ...practices spelling, math or other skills with this child. 6. ...reads with this child. 7. Subscale: School-General Involvement Some one in this family... 8. ...helps out at this child's school. 9. ...attends special events at school. 10. ...volunteers to go on class field trips. 11. ...attends PTA meetings. 12. ...goes to the school's open-house.	1. ...talk with your child about what he/she learns at the centre. 2. ...make sure this child's homework gets done 3. ..visit my child's classroom 4. ...attend Parent Teacher Conference meetings. 5. ...practice spelling, math or other skills with your child. 6. ...read with your child. 7. ....help your child with math homework 8. ...participate in parent workshops

[18] The items were selected based on the age-appropriateness and relevance to the local context

Of the ten items from the original scale, eight were selected and modified for this study to suit the age group and local context of this study e.g. The phrase 'talks with this child about the school day' was modified to 'talk with your child about what he/she learns at the centre'.

Factor analysis was run for the 34 items for subscales 1-5 as these items were considered to constitute the dependent variables after the pre-test forms were returned. This was done to confirm the key factors as well as determine the alpha coefficients of each subscale before the scores were computed for further analysis. Details of this will be reported in Chapter 6.

- Parent Perception of Specific Teacher or School Invitations to Involvement

The scale assesses parents' perceptions of specific invitations to parents for involvement from the school or teacher. (Hoover-Dempsey & Sandler, 2001-2004).

Participants were asked to respond to the following prompt: "Dear Parent, please indicate how often the following have happened since the beginning of the school year?" using the following six-point Likert-type scale (All items in the scale use a 6 point frequency response format: 1 = never; 2 = 1 or 2 times; 3 = 4 or 5 times; 4 = once a week; 5 = a few times a week; 6 = daily).

Original Questionnaire (12 items)	Modified items (General and Specific Invitations for involvement – 9 items) adapted for this study
General invitation to involvement : 1. Teachers at this school are interested and cooperative when they discuss my child with me. 2. I feel welcome at this school. 3. Parent activities are scheduled at this school so that I can attend. 4. This school lets me know about meetings and special school events.	*General Invitation to involvement :* 1. keep me informed about my child's progress in school. 2. Become more aware of the K2 maths curriculum 3. Given me useful ideas on how I can help my child learn maths at home 4. Helped me become more

5. This school's staff contacts me promptly about any problems involving my child. 6. The teachers at this school keep me informed about my child's progress in school. *Specific Invitation to involvement:* 1. My child's teacher asked me or expected me to help my child with homework? 2. My child's teacher asked me or expected me to supervise my child's homework? 3. My child's teacher asked me to talk with my child about the school day? 4. My child's teacher asked me to attend a special event at school? 5. My child's teacher asked me to help out at the school? 6. My child's teacher contacted me (for example, sent a note, phoned, e-mailed?)	involved in my child's learning at home 5. Given me confidence in helping with my child's homework *Specific Invitation to involvement :* 1. My child's teacher asked me or encouraged me to help my child with homework. 2. My child's teacher contacted me (for example, wrote a note, phoned, e-mailed). 3. I communicate with the teacher about my child's performance, progress and needs related to homework 4. I receive information on what my child is learning at the centre

Nine out of the 12 statements were selected and modified to suit the context of the study with specific reference to helping children learn math at home and becoming more aware of the K2 math curriculum.

Sample and Participants

NTUC Childcare (NCC) was selected as it offers easy accessibility to a large number of targeted population of K2 age children, whose families range from the low to middle income group.

A convenience sample (N=259) of parents and their K2 children (5 to 6 year olds) was drawn from 21 classes from the different child care centres under the NCC group of child care centres, which are located in the different districts of Singapore. The 21 K2 classes comprising 259 children, were randomly assigned to the four experimental groups: workshop only (n=70), workshop and communication (n=66), Communication only (n=75) and Control (n=48). Each group comprised children from five different centres, except for the control group which had 6 centres in order to make up for the required sample size. However, due to some staff changes in one of the centres assigned to the control group, the actual participants who subsequently consented to the study was fewer than targeted.

Table 3-5 Experimental Groups

		Number of children in each group	Participation rate (%)	No. of centres
X_2	Workshop only	70	62	5
X_4	Workshop*Communication	66	63	5
X_3	Communication only	75	62	5
X_1	Control	48	51	6
	Total	259	60	21

The centres were first selected based on the qualifications of the class teacher, who had similar professional qualifications which is a minimum of a Certificate in Preschool Teaching and /or a Diploma in Preschool teaching. This was to ensure that the minimum qualifications of the teachers were the same among all four groups, which helped to reduce any bias as a result of the differences in teachers' qualifications and to help make the classes more 'equivalent' before the grouped classes were randomly assigned to the different intervention programmes. The teaching experience of the teachers involved in this study ranged from 2-7 years. In addition, the 21 child care centres selected for the study also had a minimum class enrolment of 12 children.

The majority of the participating parents and families were Chinese (89.9%) and a small minority were Malays and Indians (4.7% and 3.5% respectively).

Table 3-6 Participants' Ethnic Groups

		Frequency	Percent
Valid	Chinese	232	89.6
	Malay	12	4.6
	Indian	9	3.5
	Eurasian	2	.8
	Others	3	1.2
	Total	258	99.6
Missing	no response	1	.4
Total		259	100.0

The age of parents fell largely within the 30-39 years age range (66.4%), followed by those in the 40-49 years (23.2%). (Table 3-7).

Table 3-7 Parent age

		Frequency	Percent
Valid	20-29 yrs	13	5.0
	30-39 yrs	172	66.4
	40-49 yrs	60	23.2
	50 and above yrs	6	2.3
	Total	251	96.9
Missing	no response	8	3.1
Total		259	100.0

Nearly half the families had a combined monthly household income of \$3,000 - \$8,000, which characterizes them as middle income families, as defined by the Singapore Department of statistics (Appendix O). Almost a third of the participants were from the lower income bracket, earning less than \$3,000 a month. A small percentage (10%) were those from the high income household bracket. Due to the sensitivity of this information, some parents chose not to disclose this information in the survey forms (8 %).

Table 3-8 Combined Monthly Household Income

		Frequency	Percent
Valid	less than $3,000	85	32.8
	$3,000-$8,000	126	48.6
	above $8,000	27	10.4
	Total	238	91.9
Missing	no response	21	8.1
Total		259	100.0

Data Collection

Letters inviting 461 parents to participate in the study were endorsed by the head of the organization and included an information sheet of the study and consent form. These were sent to all the parents of children of the K2 classes of the 21 selected centres. Of this total number, 259 (56%) parents consented to and participated in the study. Given that the participation response came from all 21 centres which were located at different parts of the country and charged the same programme fees, there was no reason to doubt that the profile of parents who consented to this study were any different from those who chose not to participate. The participation rate across the 21 centres averaged 60%. The lowest % participation rate (54%) was found in the control group. One explanation for this could be that parents did not see any tangible benefits from signing up to participate in the study. Since the pre-test assessment was conducted for the children whose parents granted consent, no pretest scores were obtained from the non- participating children, and hence, a comparison could not be made between these children.

The letters and consent forms are found in Appendix K. Parents were given the contact number and a mailing address and e-mail of the investigator should they required further clarification about the study.

A pre-test of children's math scores (a paper and pencil assessment) and parent questionnaire to measure the level of parent involvement as well as patterns of parent-teacher communication were administered a week before the intervention programme begun.

The self-administered Parent Involvement questionnaire together with a brief information sheet explaining the purpose and duration of the study were sent to each parent through the child care centres. Participants were asked to return the questionnaires in sealed envelopes to ensure confidentiality and were collected by the centre's principal after 2 weeks. The questionnaire was translated into Mandarin for the non English speaking parents.

About 1-2 weeks after the pre-test, the following programmes were administered with the different groups :

Programme 1 – Communication (Newsletters)

Parents in the X_3 groups received 3 regular weekly newsletters that provided them with up to date information on what the children are learning at school in relation to the math curriculum taught in the school[19].

Programme 2 – Parent Education Workshops

Three-weekly evening Parent workshops (over a period of 6-7 weeks) were scheduled to suit the majority of parents' preferred availability. The number of workshops were kept to three sessions as parents' busy schedules and limited time available have been taken into account as a key factor for ensuring complete and successful participation in all sessions. Parents were also loaned a set of math activity kits containing various math manipulatives and simple games with instructions on how to use these at home. More details of these will be described under the section on "Intervention and Materials".

[19] Please refer to Appendix D pp. 306-322 for samples of the newsletters

Programme 3 – Parent Education Workshops and Communication

A third experimental group was given both treatments, where parents were invited to participate in the parent education workshops as well as receive three issues of the family math Newsletters. Like participants in group 2, these participants attended 3 weekly evening workshops and received 3 fortnightly issues of the Family math newsletters.

The parent education workshops were aimed at imparting practical knowledge and skills that parents could use and apply at home to promote math understanding and skills with their children. Parents attended the workshops with their K2 child during the second and third sessions and were guided on how to use the math resource kits specially assembled for this study to help their children learn math. These activities adopted a range of naturalistic, informal and structured activities. The math kits were assembled and packaged with simple instructions and loaned to parents during the period of study.

To ensure consistency in implementation of the parent training programme, a standard format and programme procedures for conducting the parent workshops were prepared for every workshop session. (See Appendix F)

control Group

The selected control groups continued with prevailing practices of the respective centres, which did not include any newsletters or parent programmes i.e. no communication materials and no parent education workshops given to parents. As per the treatment groups, participating parents were given the self-administered questionnaire package.

The investigator worked closely with the teachers of the 10 centres (in X_2 and X_4) in developing the communication materials for parents and conducted training sessions for the teachers involved in the study

Administering the Pre-tests

The investigator undertook the task of conducting and administering the assessment as opposed to having the class teachers do this in order to prevent any 'testing' effect on the teachers, which might result in them teaching to the test and affect how they would conduct their math lessons subsequent to the pretest.

- Pre-test

The math assessments (pre test) were administered at the 21 child care centers over a 3-week period (4th week of June to 2nd week of July 2004). The assessments were conducted in the mornings, for small groups of 6-8 children. Each session lasted 30 minutes and children were given a token when they completed the assessment. To avoid distractions and noise which could affect these young children's attention, the investigator arranged for the sessions to be conducted in either a separate room or in a classroom that had fewer distractions. However, the most ideal situations were not always possible as the child care centres adopted an open concept layout and classroom spaces were not always clearly delineated and defined. Although care was taken to coordinate and schedule the best time to conduct the assessment with the teachers ahead of time at the various centres, there were still some constraints like an open space with noise distractions that had to be accepted. Also, on a few occasions, 1-2 children at some centres were absent when the pre-tests were administered. A subsequent visit scheduled at a later date (usually about one week later) had to be arranged to conduct the assessment for these children who were absent. The math assessment worksheets were graded and scored by the investigator once they were collected at the end of each week.

The Parent Involvement questionnaires were given out to parents to complete during the same period when the math assessments were conducted. The completed forms were collected by the class teachers and returned in sealed envelopes to the investigator during the period 15-31 July 2004.

- Post Tests

Post tests on children's math ability and parent involvement was conducted from 21 September to 8 October, about 8 weeks after the interventions started. The inter- testing period was 8-10 weeks for both the pre and post – math assessment and parent involvement questionnaire.

Feedback from the teachers who were involved in the workshop and communication groups, in the form of journals, anecdotal records and a feedback form, were also collected in late September 2004.

At the onset of the study, a qualitative approach to collecting data from parents and teachers through focus group interviews was planned for this study. It was deemed that a close-ended self-report surveys may not have been adequate in fully capturing the dynamic, transactional nature of parents' involvement in their children's learning at home, and that many of these processes are better explored using open-ended techniques like interviews, which would produce rich data, as well as shed light on the complex and transactional nature of interrelationships between parent involvement and its outcomes (Baker and Soden 1998).

The combination of methodologies was planned to enable the investigator gain a better understanding of parents' perceptions of their own self efficacy and the effectiveness of the interventions at the end of the study.

A qualitative method of a semi structured group interview of 45 mins to one hour was planned for selected parents to better understand what they did to facilitate their children's learning at home. Each interview group would have 6-8 members.

It was hoped that the focus group interviews, in addition to the feedback collated from parents' could help the investigator develop a better understanding of the impact of the two programmes on parenting practices and whether the interventions had helped parents support their child's development of mathematical concepts at home. These findings would have been useful towards helping to evaluate the effectiveness, relevance and usefulness of the intervention programmes and their impact on parents' self-efficacy in their involvement in their children's learning and understanding of maths. Invitations to parents to participate in the group interviews were issued in September 2004 (Appendix D).

Report on attempt to convene the Focus Groups

Towards the end of the study when the interventions were completed in September 2004, the investigator encountered an unexpected challenge in convening the focus group. Due to the limited manpower and the large amount of time that the data collection and entry took to complete, the data entry phase stretched into early December 2004, resulting in a delay in convening the focus groups which was originally scheduled in October/November 2004. However, many of the centres were very busy with their annual year end concert preparations and some families were either away on vacation in November/December 2004 or were busy preparing for the new year ahead. Due to the issue of timing, it was only possible to invite parents to attend the focus group sessions in late January 2005.

The investigator sent a total of 36 letters, followed by telephone calls to invite those who were responded to participate in a focus group interview. A token appreciation in the form of a cash voucher was offered to those who would participate in this interview as an incentive. Despite this, none of the parents invited could or wanted to attend the scheduled date of the interview in mid January. A second attempt to re-schedule another date for the interview was made, however, this also faced the same response from parents who were unable to attend, citing their busy schedules such as work, travel, and children's weekend schedules as reasons for not being able to attend the focus group interviews. This is understandable given that the beginning of the year is usually a time of significant transition for different members of the family, especially when one of the children is adjusting to the new Primary One year.

The investigator considered sending out an open ended questionnaire as an alternative but due to the nature of the interview questions, neither a written interview nor a telephone interview would have been appropriate substitutes for a face-to-face group interview. One important consideration for having a group interview was to allow participants from the different centres with varied opinions, to share, listen and respond to the questions of the interviewer as well as to the other participants' comments and views, which would result in a more in-depth discussion and yield a wider range of responses, as compared to individual or telephone interviews. Furthermore, such focus groups could also have helped to generate and evaluate data from the different participants which might help towards developing new themes to shed light on the impact of the interventions (Cohen et al, 2000).

As the investigator's approved leave of absence from work ended in February 2005, and the given time for the data collection had run out due to work commitments, it was not possible to pursue the focus group interviews due to the genuine constraints of limited human resource as well as the demands on the parents' busy schedules and their decision not to participate. In lieu of the focus group interview, the feedback collated from parents in the workshop and communication groups were used for further analysis.

Intervention and Materials

Parent Education Math Workshops (FMW)

Family Math programmes, similar to family literacy programmes, successfully teach basic math skills to both children and their parents. There is a variety of family programmes like "Family Math" and IMPACT (Inventing Maths for Parents And Children And Teachers) programme developed in Great Britain, which reaches thousands of families in both the UK and Europe. The concept of Family Math workshops adopted for this study is modeled on the Family Math workshops developed by the Lawrence Hall of Science in Berkeley. The principles of outlining each Family Math workshop are :

1. Family Math sessions educate parents to work and play with their children in order to develop positive attitudes towards mathematics. Parents and their children attend the Family Math sessions together, and all are actively involved in doing mathematics. Trained leaders facilitate the sessions, introducing games and activities that reinforce skills and develop math concepts, as well as fostering an enjoyment for mathematics. Given early support at home and in their community, children have an opportunity to maintain a positive attitude towards math through their school years.
2. Helping parents expand their parenting skills is an important component of Family Math. Parents may lack the knowledge to assist their children's development, and understand their mathematical thinking. It is important for Family Math leaders to model positive parenting skills, demonstrating worthwhile strategies to help parents relate with their children. Teachers needed to model these skills without acting in a prescriptive

manner, or appearing to be judgmental of a parent's present behaviour.

3. Parents can learn how to invite their children to share their thinking, encouraging them to communicate their understanding (or lack of it) in a safe and relaxed atmosphere. Parents can help their children see the patterns and relationships in mathematics by playing card games to practise basic skills, sorting laundry, cutlery or groceries, finding and discussing mathematics around the house (math walks) and talking about math in the daily world in which the child lives.

4. Recognizing a child's prior knowledge, and building on these early learning experiences, is essential for developing an understanding of mathematics. It is important for everyone to appreciate the value of "not knowing", and use these occasions as opportunities for growth rather than anxiety.

5. An important component of the Family Math Project was the "Literature Connection" in each session. Resources borrowed from the local library with books and information were made readily available to the families.
6. Child care arrangements and refreshments were provided to ensure that parents will not be hindered from attending the workshops due to the lack of child care arrangements for their other children. This is an important consideration as Starkey and Klein (2000) had pointed out that parent programmes and interventions work best when they respect the needs of families and the practical aspects like providing childcare at the programme during the class, providing math kits for use at home and encouraging family members to send a substitute family member to a class when necessary are important considerations and arrangements that can be made to support parent involvement.

A sample programme outline of the Family math workshops co-developed by the teachers and investigator is detailed in Appendix F.

- Math Kits to Support Learning at Home

As children learn mathematical concepts by using concrete materials to construct their cognitive understanding of mathematical concepts according to the Concrete – concept – Symbolic approach (Barratta-Lorton, 1995), the math kits were designed to facilitate this hands-on approach to learning. The use of the math kits were also explained to parents during the math workshops through demonstration and hands-on experience.

Unlike reading programmes, there are comparatively fewer and less readily available resources for parents to use at home to teach mathematics (Topping, 1998). Hence, the solution is to introduce math games or activity kits that are self-contained and readily usable, with simple instructions. In the context of parent-child interaction, games can provide more opportunities to explore ideas and more opportunities for communication and discussion that is normally available in the classroom. As it is important to make the activities enjoyable and age appropriate in order that the parents and children can relax while engaged in a a mathematical activity, the selection of materials and activities were carefully made to sustain the interest and motivation of the children.

Family math programmes employ situations and materials from everyday experience. They use models and hands-on materials (manipulatives) that allow participants to relate to the problem as they solve it. Blocks, beans, ground nuts and other concrete objects help children understand what numbers and space mean through visualization (Stenmark, Thompson, Cossey, 1986). Research by Hughes (1983), Rogers and Miller (1984) have shown that if mathematical content can be contained in play form, motivation for learning will also be so powerful that the question of 'relevance' will never arise for the child (Topping and Bamford, 1998). Many advantages have been claimed for a gaming approach to mathematics (Kirkby, 1992) as it can promote active involvement, are intrinsically motivating, and help avoid boredom. They are grounded in concrete meaningful experiences and have a purpose in which the child is is engaged, helps promotes decision making and problem-solving. They also enable a grasp of mathematical concepts to be deployed, demonstrated and practiced before children are ready to grapple with abstract symbols and recording.

Hence, the Math kits for this study were designed to help :

- Children become more familiar with the mathematical language and feel more positive about mathematics
- Parents to help their children learn more about mathematics through playing games or working through the activities and talking about them
- Parents understand that mathematics is not just about computation : it is also about learning about relationships, patterns
- Parents understand that mathematics is part of everyday life and is essential to everyday problem-solving
- Parents and children enjoy mathematics

Games and puzzles were also included in the math kits as they have a number of other advantages. They :

- Are generally part of normal home experiences
- Can be highly motivating because the child is actively participating and is in control
- Involve immediate feedback and an element of gameful competition
- Have well-defined directions
- Can provide meaningful experiences, connecting the concrete reality and the abstract symbols
- Can be used to consolidate class work or to encourage and enable a child to extend his or her skills

- Encourage parents and children to enjoy and learn math concepts in a fun way

The math kits[20] were made available for parents to borrow after they have attended the first math workshop to ensure that they know how these kits are to be used and the purpose for them. Each child was encouraged to borrow 1-2 kits a week, over a period of 10 weeks to enable parents to conduct the activities with the children. Hence, at the end of the 10-week study, most children would have been expected to have borrowed up to eight or ten different math kits, covering a range of maths concepts.

Teachers also provided support and explanation to parents / grandparents if they needed help and instructions on how to use them. Children's loans of the math kits were monitored and recorded in a checkout sheet for each child, kept by the class teacher.

The math kits were also selected and designed to meet the following criteria. They were planned to :

- Facilitate enjoyable and provide meaningful experiences in counting, one-to-one matching, comparing more-less, simple addition and subtraction
- Promote both competition and cooperation between child and parent i.e. The game would not solely be skills based but also involve both chance and skill. Some of the games included card games and board games, like Snakes and Ladders, BINGO which made use of die and playing cards
- Be easy to understand – age appropriateness for each activity was also taken into consideration and the language in which the instructions were written had to be simple to understand and follow

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[20] Ideas for the math kits were also adapted from Barrata's (1995) Mathematics Their Way

- Be flexible and allow extension – parents were encouraged to add on their own ideas to modify the games and activities if they were too simple for their children
- Encourage discussion and development of mathematics vocabulary
- Be robust – both physically and in terms of durability
- Not look like school work
- Be attractive – use of colourful tokens such as coloured plastic shapes, assortment of beans, stickers, sorting cups and pictures so that children would want to use them
- Be well packaged and easily kept together – each math kit was self-contained and kept in a ziplog plastic bag that would fit easily into the children's school bags
- Be inexpensive – everyday materials were used, to demonstrate to parents that mathematical concepts can be taught using ordinary everyday household items

A total of 30 math kits[21] were developed to encourage parents to work with their children at home. Each kit provided math activities and manipulatives for children to use and covered the following math concepts which were the core concepts selected for the purpose of this study that children needed to know when they entered primary one :

Counting, Cardinal numbers (1 to 20), Ordinal numbers (1st to 10 th), More, less, Number line, Number Operations : Number bonds, simple addition, Simple subtraction, Matching, Sorting, Patterns, Handling data – Simple graphs.

[21] Please refer Appendix H for sample pictures of the math kits

Table 3-9 Different Math Activity Kits Organized according to the Math Concepts

Counting	Graphing /Sorting and Patterns	Addition/ Subtraction	Games
1. Matching Sets 2. Race to One Hundred 3. Two dice 4. Groundnuts 5. Make a Number line 6. One more, one less 7. Hundreds Board 8. Guess and Group 9. Off we'll go !	1. Sorting activities 2. Goodness gracious graphs 3. What is your favourite ice cream ? 4. Toothpick, paper clips 5. Shape patterns	1. Adding with dominoes 2. Ladybugs and Leaves 3. Raisin bread 4. Find the solution 5. Tub Games 6. Flip cards	1. Connect 4 2. Snakes & Ladders 3. BINGO 4. Ludo 5. Go Fish / Make Eight 6. Happy Families 7. Snap ! 8. Old Maid /Donkey

Each math kit activity was collated and developed to support the learning of a particular math concept e.g. counting, comparing, sorting, patterning, simple addition and subtraction (within 10) and some games of chance.

Math Workshops for Teachers

Principals and Teachers of the selected 10 child centres (5 from the workshop and 5 from the workshop & communication groups) attended 6 hrs of training, spread over 2 weeks on how to plan and conduct in preparation for conducting 3 sessions of 2-hr Family Math workshops (FMW) for parents. The workshops aimed to provide both the centre principals and the K2 class teachers with an understanding of the rationale of the FMW and their role in the study. They were also introduced to the different math kits developed for the study and on how to use them. Outlines on the sessions, materials to use and sample home activities were given to the centre principals and teachers.

The training that was planned and conducted for the teachers involved in this study was an important part of the intervention (i.e. conducting parent workshops) itself, as it was important to help the teachers understand the importance of planning and facilitating parent involvement through attending workshops that would help them gain a better understanding of the resources available and their roles in helping their children's learning at home.

The workshops for the teachers were also important in helping teachers to understand and convey to parents how to use the math kits at home with their child. Teachers played an important role in supporting and guiding parents in helping their child learn math at home through developmentally appropriate activities and materials provided.

The appropriate use and administering of the math kits were explained to the teachers. The inventory list of math kits was also introduced to the teachers: The investigator explained the proper use of the materials and demonstrated the use of the kits to the teachers. Teachers were requested to provide parents with basic assistance of explaining the kits if they had any difficulty in using them.

It was also important to help teachers adopt a common framework for planning and delivering the workshops to ensure consistency in both the content as well as imparting appropriate ideas in helping parents to learn how they can support their children's math learning at home through the use of the math kits. During the workshops, teachers were involved in the planning of the detailed programme for each workshop sessions, which helped them to be more confident in facilitating the workshops for the parents.

The investigator adopted this approach for the teachers and centre principals to be the key facilitators of the workshops rather than take on the role of running all the workshops by herself. It was deemed more appropriate that the teachers, having established strong relationships and familiarity with the children and their parents, would be in a better position to share and relate what they are teaching the

K2 children with the parents as compared to the investigator herself. This approach also helped to strengthen the ecological validity of the study by ensuring that the experiment approximates the real-life situation and does not disrupt the continuity of the ordinary environment.

The training began in late May and ended in early June to allow teachers ample time to prepare for the workshops to be held from early July to end August 2004. Upon completion of the training, the individual centres were given a standard programme template to follow (See Appendix F) as a guide to planning their Family Math workshops (FMW). However, as there was no standardized[22] curriculum across the different child care centres, the math activities for the workshops was left to the teachers to decide so that they could align the workshop sessions to what they were teaching the children on a week by week basis. Since a guideline for the math workshops were the same across the 10 centres, this would help ensure a level of consistency for the FMWs. Furthermore, the investigator worked very closely with each teacher in planning and conducting the workshops which were held during the evenings to cater to working parents. The workshops covered the following topics :

- Importance and benefits of parent Involvement
- Overview of the study
- Teachers' role in the study
- Math concepts to be covered during the Family Math workshop sessions
- How children learn and assimilate math concepts and skills – Concept- Connecting – Symbolic
- Learning outcomes for K2 math curriculum – comparison with the Primary curriculum

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[22] This point will be addressed as a limitation of the study on pp. 105

- What are Family Math programmes and how they can be conducted and implemented
- Planning the 3 Family Math Workshop sessions – guidelines and group work
- Use of the math activity kits as a means for home involvement
- Appropriate dispositions and attitudes towards math to cultivate
- Inventory for the math Activity Kits and how to use, organize and put them on loan

To ensure consistency, the first workshop session with parents was conducted by the investigator and the class teacher; while the subsequent 2 sessions were conducted largely by the class teachers after consultation with the investigator on the math activities.

The loan record system for these kits was also explained and staff were reminded to stress that the math kits must be used under parental supervision as there are small manipulatives that are not suitable for children under 4 years old – this same reminder is printed in the letter to parents to accompany every math kit that was sent home.

Teachers were asked to organize a loan scheme where each K2 child participating in the study gets to borrow the 1-2 kits on a weekly basis during the period of study for about 8 -10 weeks. Staff were also asked to keep close track of each child's borrowing of the math kits as well as to collect the feedback forms from parents each time each kit was returned to the centre. Teachers were also asked to check and replace missing pieces when the kits were returned.

Details of the various evaluation forms and feedback to collect from parents were also explained to them, and they were given a folder containing all the sample evaluation forms and attendance sheets etc.

- Feedback and Evaluation from Parents and Teachers :

Feedback and evaluations from both parents and teachers were solicited in the form of a simple survey form (Appendix L). Their responses to the Family Math workshop and math kits were sought to better understand the impact, concerns and issues parents and teachers faced in relation to the family math workshops and the newsletters. The responses were tabulated and summarized in Chapter 4. Teachers were also invited to share their own reflections and thoughts of the FMW sessions which they conducted.

Family Math Newsletters (FMN)

The purpose for using newsletters as a form of communication with parents were :

1. to share information with parents on how they can help support their child's learning and development of basic math concepts using day-to-day experiences and materials available in their home
2. to keep parents informed of what their children were learning in relation to the subject math, at the the child care centers
3. to empower parents with information and resources to enable them to know where to find helpful aids and resources via books and the internet

Three issues of Family Math newsletters were designed using Microsoft Publisher and distributed to parents in the Communication group and the workshop*communication groups during the period of intervention, 5 July – 12 August 2004. Each issue was prepared and distributed every two weeks.

Where possible, graphics and photos of children's activities conducted at the centres were included in the newsletters to make them more interesting and meaningful to the parents. Useful links to websites on math resources and titles of suitable math resources books that are available at the neighbourhood libraries were also included in every issue. The contents of each newsletter are summarized as follows and hard copies of these are found in Appendix D pp. 296-314).

1. Newsletter 1
   - Introduction to family math and the importance of parent involvement in supporting children's learning at home
   - Doing maths at home – suggestions and ideas on how families can be involved
   - List of learning outcomes for the K2 curriculum
   - List of math activities and games that can be carried out at home using playing cards, dice, beans etc.
   - Math-Literature connection – a selected list of recommended concept books were printed. These included : "Bubble Trouble", "Anno's Mysterious Multiplying Jar", "The Blue Balloon", "The Doorbell Rang".

2. Newsletter 2
   - Doing Maths with your child – tips for parents on how they can support and motivate children's interest in math
   - A journal anecdotal record of a field trip to the supermarket made by two child care centres, summarizing the key learning experiences of the children that related to math concepts and skills e.g. grouping of food items, comparing prices of food items, making purchases etc.
   - List of math vocabulary
   - Math-Literature connection – a selected list of recommended concept books were printed. These included : "Anno's Counting Book", "One Guinea Pig is not enough" and "The Best Bug Parade".
   - Websites for additional resources and math ideas for parents : http://www.mathsurf.com/parent/index.html

3. Newsletter 3
   - Building a strong math foundation at home – guidelines for parents to cultivate a suitable environment at home to develop math skills and understanding
   - List of math games and activities e.g. making a number line (counting forward and back), counting large number of objects – grouping in tens, number bonds – simple addition within 10, ordinal numbers – ordering items 1^{st}, 2^{nd}...10th
   - Checklist for helping with child's homework
   - Math-Literature connection – a selected list of recommended concept books were printed. These included : "Let's Count it out, Jesse Bear", "Anno's Magic Seeds" and "Give me Half".
   - Websites for additional resources and math ideas for parents : http://www.geocities.com/EnchantedForest/Dell/5232 and http://ni.e.redding.com/community/nie/activities/act_family_math1.shtml

Feedback on the newsletters were collected in the form of a short feedback form (Appendix M). These will be reported in the Chapters 5 and 6.

Limitations of Study

The sample of the study was not drawn from the entire population of parents of 6 year olds from the different child care and kindergarten settings in Singapore, as seeking consent and participation from these centres was not easy nor feasible. The investigator took a pragmatic approach to sampling and decided that it was more practical and realistic to work within an organisation that she is familiar with, as there is strong support for the study from the management, and relatively little red tape to clear before approval is given to proceed with the study.

The issue of internal validity of the study was addressed by taking the necessary measures including random assignment of classes to the different experimental groups, to ensure that the intact classes are 'probabilistically equal' as well as selecting teachers with similar teaching qualifications.

However, as in any educational research conducted in a human context, the presence of social threat through the occurrence of social interaction between and among subjects is inevitable. Even though the investigator did remind the participating teachers to keep what have been taught to them to themselves and to refrain from sharing what they learned from the workshops with other staff for the purpose of internal validity, it was not possible to completely prevent the teachers from the other participating centres from contacting the teachers in the workshop groups to compare and exchange notes in relation to the materials used in the different intervention groups. Hence, some degree of threat of diffusion or imitation of treatment in that the teachers from the non-workshop or non-communication group could have taken place, which could have impacted the teaching methods adopted by the teachers from the groups not receiving the same intervention. Fortunately, during the study, there were no concerns raised by parents who were concerned that their child was not included in the workshop group.

There was also some subsequent attrition of participants (ranging from 1-3 children in 4 centres) due to withdrawals and transfers of children across the different centres. In particular, the control group size started with a smaller number of consenting participants compared to the other three experimental groups even though it started with six classes. One of these centres selected to be part of the control group faced a slightly higher attrition rate due to staff movements. On hindsight, the lower participation rate in the control group could also be due to the lack of a tangible benefit provided for participation, as perceived by the parents.

Due to the limited manpower resource, a relatively small scale study of 21 classes selected from one child care organization and randomly assigned was conducted across different locations over a relatively short duration. The external validity of this study is therefore limited and cannot be generalized to apply to the total population of K2 age children and how their parents and centres are working together to support parent involvement at home. Instead, the findings of this study, at best can be applied, to some extent, to children and families who come from similar SES backgrounds to those studied.

In adopting a predominantly experimental approach to conduct the study, the need to work with intact classes is preferred as it facilitates the monitoring and implementation of the parent education programme and its effects. This also helps to improve the ecological validity of the study by using the actual environment as the test environment.

Other limitations in relation to the study's design were :

- Firstly, participants were drawn from a convenience sample and are not representative of the overall population of K2 children in Singapore
- A larger number of participants though preferred, because it can generate more power in the statistical analyses, was not practicable
- The criterion-referenced math assessment was designed and piloted by the investigator for the purpose of measuring children's math scores which had limitations of a ceiling effect
- The parent involvement questionnaire is a modified instrument adapted from various related scales for the purpose of this study and does not yet have established psychometric properties. The modifications were deemed necessary to suit the local culture and context of the study. Therefore, the study at best can be considered an exploratory study.

- Due to the practical considerations of a lack of a standardized math curriculum in the centres, the investigator chose to allow teachers to modify the activities used in the parent workshops to help them relate to their parents in a more meaningful way, whilst concurrently ensuring that the teachers followed a prescribed programme for each of the evening workshops.
- The lack of a standardised math curriculum could have disadvantaged some of the centres

The duration of the entire period of intervention was around 12 weeks. Reasons for this proposed span of time were :

The two treatment programmes i.e. communication and workshop*communication can be feasibly implemented within this time frame and some effects of these programmes can be expected after 8-10 weeks, given the young age of the children.

The threat of maturation is less likely if the duration of the programme is kept within a span of not more than 3 months, as there is unlikely to be a surge in growth in children's math understanding even in the absence of any given programme over this period.

- Most K2 children already enrolled in the child care centres stay for at least the entire year. Hence, it is unlikely that during the period of 2-3 months, there would be a high mortality or drop out rate. This was an important consideration for completing the data collection within a 5-month window period (May to September) as it would be almost impossible to follow-up with the children and their families after they leave the centres, usually between November and December.
- Due to very limited manpower available for the implementation of this study, which was a major constraint faced by the investigator, it was not feasible to extend the duration of the study to follow-up on the children's math learning after they transition into the primary school.

- The investigator recognizes that the short duration of the intervention of only three parent education workshops could have been a setback in terms of changing attitudes and parenting practices such as parental confidence /efficacy and role construction, which generally would require longer periods of time and more sessions of education workshops. However, this concern was addressed through the use of math kits which made parent involvement at home easier for parents in the groups with the workshop condition, which were given to parents on a weekly basis for the entire duration of the intervention, and this strategy was thought to have compensated for the few number of parent workshops.

Methods of Data Analysis

In a two-factor experiment, two kinds of treatment effects : main effects and an interaction effect are possible. As this study is designed as a 2 factor (workshop and communication) factorial experiment, the main statistical method used to compare the group means was the 2 factor ANOVA with covariates.

Factor analysis will also be run to ensure that the key factors in the parental confidence and involvement instrument are organized into distinct factors before the scores of each of these factor dimensions are computed for further analysis.

Feedback from the parents and teachers from the three treatment groups were collated and summarized to provide further insights on the impact of the treatments as well as help to address the research questions of this study. These will be presented in the next chapter.

4. FEEDBACK FROM PARENTS AND TEACHERS ON THE WORKSHOPS AND NEWSLETTERS

Introduction

This chapter presents data collected from the parents and teachers in the three treatment groups (workshop, communication, workshop*communication). The findings reported in this chapter will also help to expand on the quantitative data collected and presented in Chapters 5 and 6 as they provide evidence and insight in relation to the implementation of the experiments and the reception of the treatments by teachers and parents. The feedback from parents and teachers also offers a more in-depth perspective on how parents have benefited from the different treatments. The data presented in this section are also applicable for hypothesis testing and addressing the research questions of this study.

The following sections report the feedback from parents concerning the (a) the parent math workshops (b) the family math newsletters and also (c) anecdotal records written by the teachers' of the observations and reflections on the parents' and children's response to the workshops

However, the investigator recognizes that the feedback from parents is not representative of all the views of the parents who participated in the workshops and who received the newsletters since not all parents completed the evaluation forms.

Parents from the three treatment groups were given evaluation forms that requested their feedback on the workshops and the newsletters that they had attended or received.[23]

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[23] Please refer to Appendix L, for the samples of the feedback forms.

The following Table summarizes the number of evaluation forms collected from the participants from the different experimental groups :

	N
Workshop	64
Communication only	59
Workshop*Communication	56
Total	179

Participants were given evaluation forms designed to gather their feedback on the parent workshops and the newsletters that they received. For the workshop*communication participants, they were given two evaluation forms, one for the newsletter and another set on the workshops to complete.

Parents who attended the workshops were given the forms to complete at the end of each session. These forms were collected across the three parent workshop sessions and due to the option given to parents to remain anonymous, some of these forms could have been written by the same parents from the various centres.

However, as participants preferred to remain anonymous, the feedback given could not be traced back to the individuals. This arrangement was preferred by the investigator so as to encourage more open and honest feedback from parents, who may be wary of affecting the teachers' feelings.

Although it may be possible that some feedback given could have had some social desirability effects due to working relationships between parents and teachers, the feedback given can still be regarded as being objective since the choice to complete the forms was entirely voluntary and anonymous.

Parent Math Workshops

In addition to some fixed response questions, parents in the treatment groups with workshop condition were asked the following open-ended questions and their feedback are summarized as follows :

- What did you like best or find most useful about the session?
- What could be better next time?
- What ideas / skills did you learn that can be applied to help your child learn at home ?
- Do you have constructive suggestions for this instructor?

At the end of the series of three Family Math workshops, parents were given a feedback form comprising 12 questions. A 5-point likert scale where 1 = strong agree to 5 strongly disagree was used. A total of 120 forms out of a total of 136 parents who attended the workshops in the 2 experimental groups were collected.

A summary of the responses to each of the items are as follows :

From Table 4.1, an average of 80% of parents who attended the parent workshops indicated (agree/strongly agree with the following statements) that they benefited from the workshops :

Table 4-1 Summary of Parents' Responses to Workshops

Items on Evaluation form	Disagree %	Neutral %	Agree %	Strongly agree %
1. Because of this workshop, I feel more confident in helping my child with his /her math	1	16	65	18
2. Because of this workshop, I will be able to make use of materials at home to help my child learn	0	12	67	21
3. Overall, I found this workshop useful.	0	11	69	20
4. The workshop will help me with my parenting skills	1	19	63	17
5. The information provided was useful.	0	11	69	20

6. The instructor was knowledgeable	0	8	63	29
7. The activities and materials presented useful	0	11	66	23
8. I would recommend this workshop to others	1	15	55	29
9. I would attend another Parent math workshop	2	13	57	28
10. The pace of the workshop was ok for me	1	10	58	31

Because of this workshop, I feel more confident in helping my child with his /her math. 83% agreed/strongly agreed with the statement. Because of this workshop, I will be able to make use of materials at home to help my child learn. 88% parents agreed/strongly agreed with the statement.

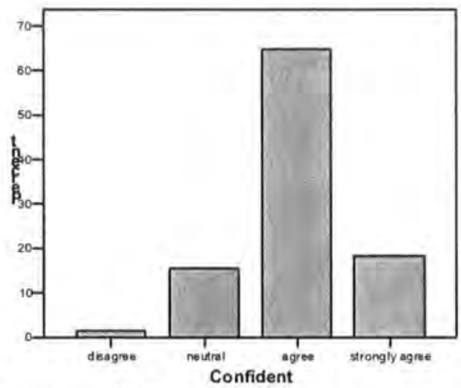


Figure 4-1 Confident

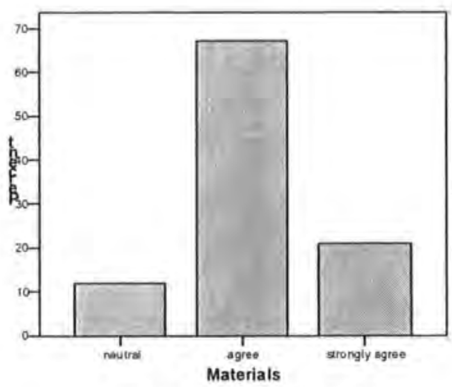


Figure 4-2 Materials

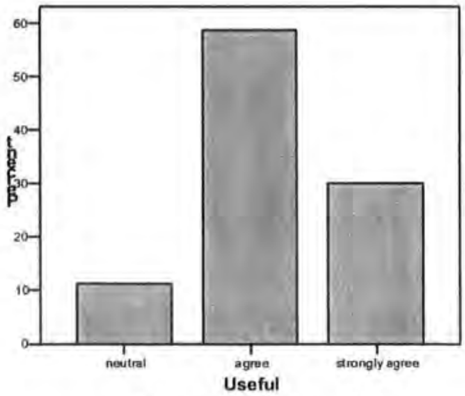


Figure 4-3 Useful

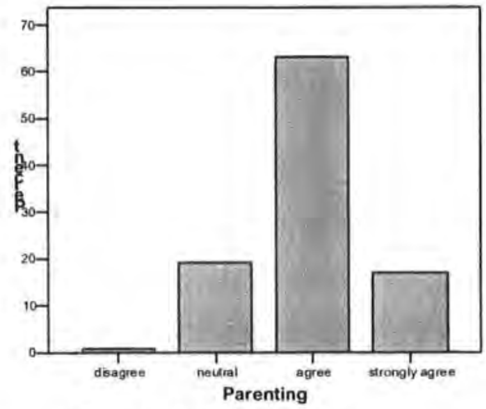


Figure 4-4 Parenting

Overall, I found this workshop useful. 88.8% agreed/strongly agreed with the statement.

The workshop will help me with my parenting skills. 79% agreed/strongly agreed with the statement

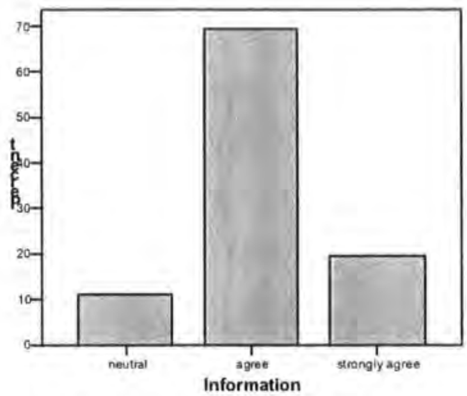


Figure 4-5 Information

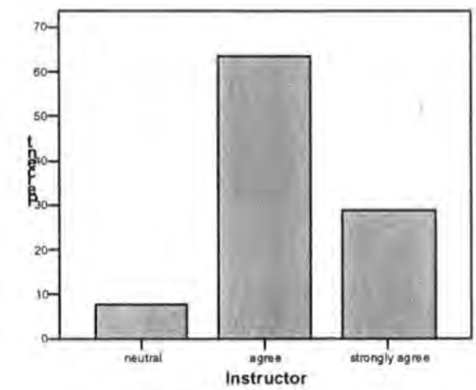


Figure 4-6 Instructor

1. 86.8% agreed/strongly agreed that the information provided was useful.

2. The instructor was knowledgeable. 91.6 % agreed/strongly agreed with the statement

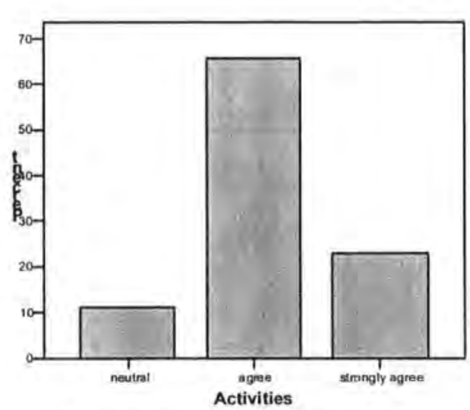


Figure 4-7 Activities

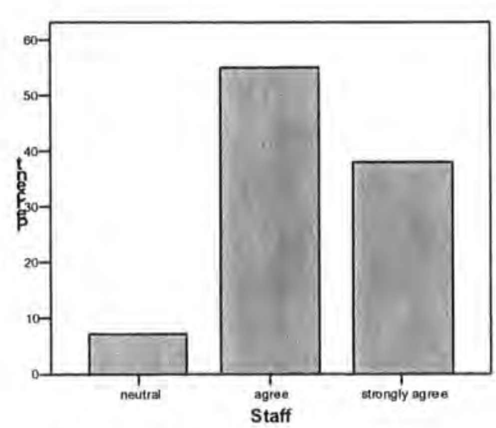


Figure 4-8 Staff

3. The activities and materials presented useful. 88.8% agreed/strongly agreed with the statement

4. The staff were approachable and helpful. 92 % agreed/strongly agreed with the statement

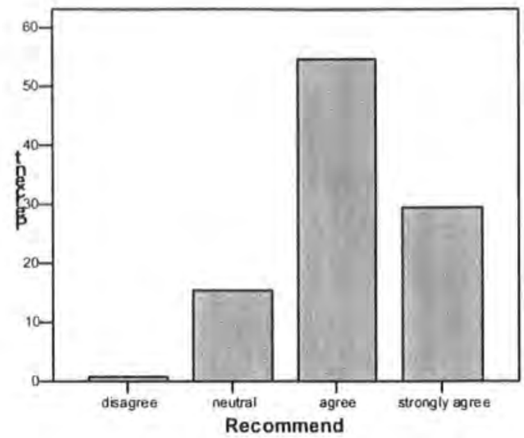


Figure 4-9 Recommend

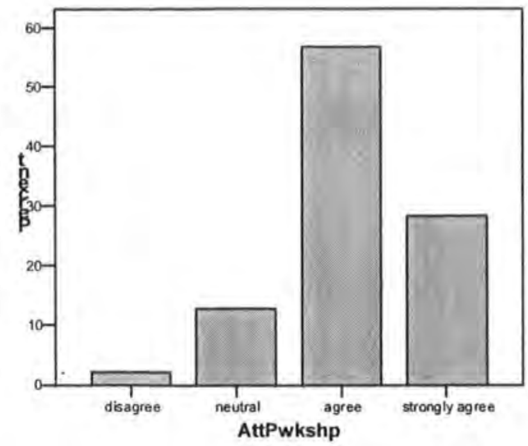


Figure 4-10 Attend Workshop

5. I would recommend this workshop to others. 84 % agreed/strongly agreed with the statement
6. I would attend another Parent math workshop. 84% agreed/strongly agreed with the statement

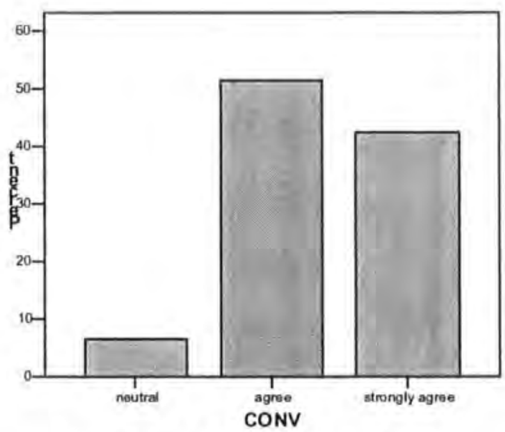


Figure 4-11 Convenient

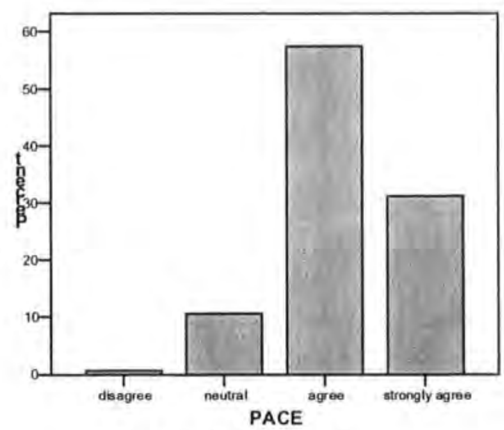


Figure 4-12 Pace

7. Being able to have this workshop in the child care centre makes it more convenient for me. 93% agreed/strongly agreed with the statement
8. The pace of the workshop was ok for me. 87% agreed/strongly agreed with the statement

Workshop Group

In response to the question, "What did you like best or find most useful about the session?", parents commented that they enjoyed the opportunity to exchange experiences that enhanced their unlearning of the old ways of memorizing and to learn to present math in a more fun and creative way. They also found the activities and games most useful in helping their child to develop and learn more math at home, especially in using materials at home.

Some parents noted that they now have a better understanding of how math is taught in Primary One i.e. having a better idea on what the P1 mathematics syllabus is like and also on how to tackle problems in coaching my children with their work such as using the number line and objects to teach math in a creative way. One parent commented that "throughout the workshops, I've learnt useful tips about everything on math, making it very interesting through play, and it has enabled me to teach my child confidently. I thought I was going to be hopeless to teach my child math, but this workshop really gave me a change of math teaching concept through play and illustrations. Thank you."

A parent shared that "math can be taught in so many different ways. My method of teaching math somehow appears too rigid for my child and it seems I am not the only one to deliver it. These new ways certainly help in the teaching of math to my child. Very satisfying to know all these! Thanks."

Other aspects of the workshops that parents found to be most useful included learning the different ways to teach math rather than the traditional ways, how to teach children math through fun games, and the different ways and variety of techniques in imparting mathematic concepts. One parent commented that the workshops had helped her to "Get to know other parent's teaching woes and problems", which reflected the importance of peer support in parenting.

The workshops also gave parents "the skills and techniques to handle math effectively" and allowed both "parent and child to get involved in the activities at the same time, allowing the parent to 'gauge his (child) learning abilities". Parents shared that they learned words like 'take away', 'less than' for subtraction.

- What could be better next time?

Parents also had some suggestions for improvement including weekends being preferred timing compared to weekday evenings and having the sessions conducted in Mandarin. Workshops for other topics such as language and reading were also requested by some parents.

- What ideas / skills did you learn that can be applied to help your child learn at home ?

The feedback and comments that parents wrote in this section showed a qualitative shift in their approach to teaching their child math at home. Many parents shared that learning through real life problems and the use of physical objects like beans, playing cards and drawings have helped their child develop a clearer picture and understanding of mathematical concepts. The discovery that parents made about learning can be fun and applied to daily things that can be found at home rather than buying expensive materials was encouraging. A parent commented that "Math can be taught in a fun way that can also involve other family members instead of just one parent". Parents shared that they learned new techniques and skills, such as the number line and graphing using various materials that are available at home to teach their child instead of forcing them to do homework, such as assessment books and appreciated the relevance of reading more math books to improve their children's mathematical vocabulary.

Parents also learned the application of a mathematical activity in multiple ways which if left on their own, would have been 'hard to figure out by ourselves'.

The study also found that parents' rating of the importance of helping children with math (parent encouragement) was associated with reporting more helping behaviours in math, suggesting that parents may be particularly responsive to teacher suggestions in math as reflected by the various statements made by parents who attended the math workshops follows :

1. *The workshop(s) have helped me in the following ways:*
   a. I thought I was going to be hopeless to teach my child math, but this workshop really gave me a change of math teaching concept through play and illustrations. Thank you.
   b. learn useful tips about everything on math, making it very interesting through play, and it has enabled me to teach my child confidently. Thank you.
   c. learn the concepts about number bond
   d. use the number line and objects to teach my son math in a creative way. And I got the idea of how math is taught in Primary 1.
   e. given me skills and techniques to handle math effectively.
   f. have a better idea on what the P1 mathematics syllabus is like. And also on how to tackle problems in coaching my children with their work.
   g. Learned ideas on how to inculcate math concepts/interest in child
   h. a better understanding of how the primary one math looks like
   i. use the correct question to ask my child related to math
   j. become more flexible and creative thinking in using the material
   k. understand what the children will be learning In school

l. given me the information regarding concepts would be very useful in teaching my child in everyday talks and activities
m. learn the language to be applied during the math activities
n. understand the different concepts and using everyday seen materials

2. The workshops have helped me to understand the use of manipulative in teaching mathematics to my child in order to

a. help my child to do calculations using objects/
b. teach math in so many different ways. My method of teaching math somehow appears too rigid for my child and it seems I am not the only one to deliver it. These new ways certainly help in the teaching of math to my child. Very satisfying to know all these! Thanks
c. use things that can be found at home rather than buying them from outside. Math can be taught in a fun way that can also involve other family members rather than one to one.
d. conceptualize using concrete or solid objects.
e. find out how to use the things around us to relate to math
f. make use of materials at home - -like using beads to teach math, learning with interest with simple toys to relate with numbers
g. learn how to encourage and help my child in her math
h. learn hands on skills -by using different materials to learn math other than paper and pencil

3. The workshops have helped me learn to teach math concepts to my child by using daily activities /experiences

a. use daily activities like home chores can be easily adapted to teach math
b. use the correct math language to use when teaching my child and the ways to introduce the concept to them on a more concrete base manner inculcating the child's interest in

mathematics concept like fractions, sorting, patterning, bonding

c. use manipulative skills, counting, addition, subtraction, multiplication estimating , number line to learn more than less than
d. learn to help my child to add by counting forward, using the number line, patterning

Workshop and Communication Groups

In response to the question, "What did you like best or find most useful about the session?", a common theme that was found in the feedback from these groups related to the importance of the workshops in relation to helping them prepare their child for Primary One as they found the information shared about the P1 syllabus helpful and relevant as they now have a better understanding of what their child will be learning in school.

A second theme that emerged from the feedback was the importance of the practical hands-on sessions that the workshops provided, which gave parents a better understanding of "what is math and how to promote math at home". One parent commented that she learned "the types and ways of teaching math can be so interesting that we never realized at all before attending this workshop". Some parents also shared that it (workshops) enabled 'us to associate daily activities to math concepts so that learning can be interesting and fun for the child". The 'social' factor of parents gathering together was also a feature that parents commented were helpful as they 'liked the sharing opportunities with other parents and parents have a chance to learn together". Learning was also perceived as being 'more fun and improved relationships of family members'. The openness and sharing in a casual atmosphere coupled with the comfortable pace and good support materials helped make the sessions more interesting.

Parents also found the variety of the math kits to be useful and interesting as they found their child really enjoying the games and kept asking the parent to play with her. Parents learned how to use the things as manipulatives around them to teach math and to "make math interesting for my child". Through the workshops, parents felt that they had a better idea of "what is math" and "how to promote math at home".

A parent also commented that "I'm glad that the instructor is a parent herself. It makes her knowledge and experiences more practical and believable. I especially like the part when she shared about the ordinal numbers".

- What could be better next time?

Feedback was mixed as some parents preferred the workshop sessions to be shorter, while some preferred more activities to be included.

- What ideas / skills did you learn that can be applied to help your child learn at home ?

Parents described the specific knowledge and skills that they gained from attending the workshops which included the use of the number line to help teach their children 'more' and 'less'. Number bonds using objects like beads was a useful concept that they learned to teach addition and subtraction. Parents commented that learning math was not only through assessment books but through using concrete materials like beans, lego bricks etc. Daily experiences like doing housework and cooking at home can also be learning opportunities for children to develop math concepts such as sequencing, fractions, counting, addition and subtraction. One parent also shared that she learned to use the "correct math language when teaching my child and the ways to introduce the concept to her in a more concrete manner".

Another theme that surfaced from the evaluation was that parents realized that "we can teach math anytime, any where using everyday materials and activities to teach the different concepts". The math kits were also deemed as a good starter for some parents who took the ideas and expanded on them at home. Through the math kits and materials provided, parents were able to apply what they learned during the workshops to at homes in teaching their child to learn math.

One of the main differences in these parents' feedback were reflected in this aspect of how they could use everyday materials and experiences to teach their children math at home. This was one of the key message that was carried through the Newsletters that were given to parents and the games that were suggested for parents to carry out at home were highlighted in the feedback.

Perhaps one of the most significant feedback point was the fact that parents learned that teaching math need not always be a paper-pencil approach and the attitude shift from using assessment books to that of adopting everyday materials, games and experiences was a major transformation in their belief system and approach to helping their children learn.

Feedback on Math newsletters

At the end of the series of three Family Math Newsletters, parents in both the communication and workshop*communication groups were given a feedback form comprising 5 items. Due to the difference in the nature of the intervention i.e. written communication through newsletters, a different set of feedback questions from that of the workshop groups were used to evaluate how parents perceived the usefulness of the content in the 3 newsletters.

Due to the lack of access and opportunity to observe these parents helping their child learn math at home, the investigator could only rely on the comments in the feedback forms as the most direct source of information concerning the impact of the newsletters on parents' understanding of how to help their child learn math at home.

Parents were asked how they found the information in the newsletters to be informative, interesting, useful, easy to understand and beneficial to them. For this, a 5-point likert scale where 1 = strong agree to 5 strongly disagree was used. A total of 115 forms from 141 parents were collected. Findings from the 2 experimental groups (communication and workshop*communication groups) are summarized and presented in the following sections :

The responses tabulated form parents who received the newsletters show that on average, 66% agreed /strongly agreed with the statements that the newsletters were informative, interesting, useful, beneficial and easy to understand.

A summary of the responses to each of the items are as follows :

Table 4-2 Summary of Parents' Response to Newsletters

Items on Evaluation form	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly agree %
1. I found the Family math Newsletters to be Informative	1	4	30	41	24
2. Family math Newsletters were Interesting	2	6	28	37	27
3. the Family math Newsletters were useful	1	4	34	30	31
4. Family math Newsletters were Easy to understand	0	5	30	38	27
5. Family math Newsletters were Beneficial	0	5	29	34	32

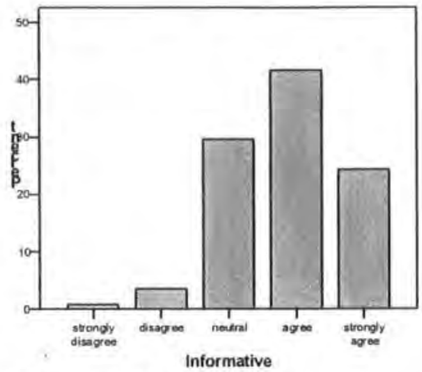


Figure 4-13 Informative

66% of parents found the newsletters to be Informative

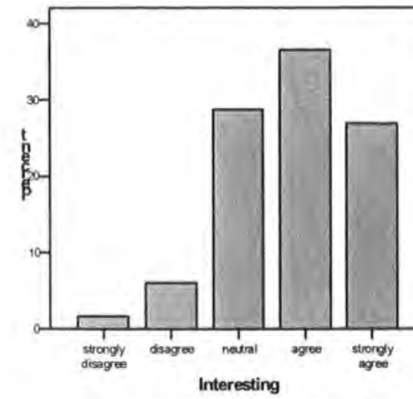


Figure 4-14 Interesting

64% or parents found the newsletters to be Interesting

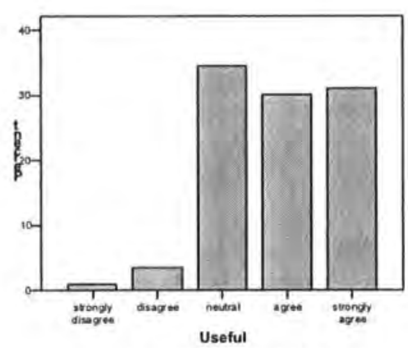


Figure 4-15 Useful

61% found the Family math Newsletters to be useful

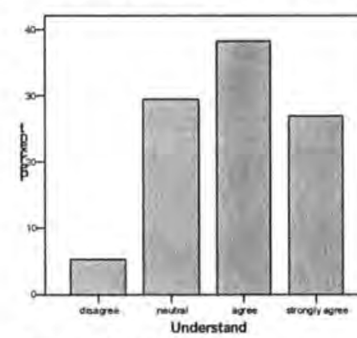


Figure 4-16 Understand

65% found the Family math Newsletters to be Easy to understand

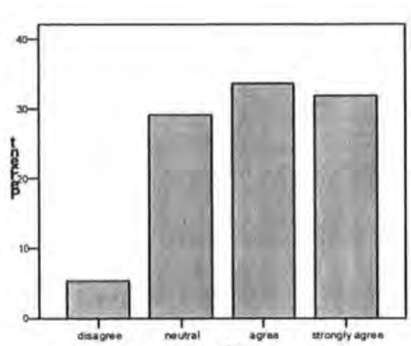


Figure 4-17 Beneficial

64% found the Family math Newsletters to be Beneficial

Workshop & Communication Group

In addition Parents were asked to respond to 2 open-ended questions and their feedback are summarized in the following sections :

- Which type of information in the newsletters were most helpful /least helpful to you ?

The information contained in the various sections and content of the newsletters were commented on as being the most useful. These included the math games, the checklist on how to help your child with homework, number bonds, websites and books recommended in the resources section as well as the suggested math activities such as cooking and shopping activities, patterning (shapes) activity, making a number line, snake game, number bonds etc that parents could carry out at home with children. Parents described these activities as useful in helping them to help their child with math and being 'adequate at this level for my child which were easy to understand.'

One parent commented that the newsletters helped her in the following ways :

1. Build a strong math and science foundation at home (solving problems)
2. The math games are very useful, it helps my child in his math
3. The websites, games and the recommended books information are good
4. The newsletters gave ideas to make math in a fun learning man

One parent commented that the section where the different math lessons being conducted at the different child care centers were also thought to be useful.

How can the Family Math newsletters be improved ? What other information would you like to receive through the newsletter ?

Parents' suggestions included having some activity /worksheets or fun games related to math so that their child could practice to help their child be more proficient. A Parent also commented that the newsletters was a source of information on how to teach math at home. I hope that there will be more of such'. Some even wanted more quizzes and math games and a helpline for them to clarify should they needed further assistance, and asked for :

> "Other information such as "how to prepare K2 child for primary school" as well as the sources where parents can buy the math resources and books that were recommended for the child care centers was also mentioned. I think it would be perfect if the newsletter could have more activity sheets added on to it for the children to practice".

Communication Group

In response to the question : "Which type of information in the newsletters were most helpful /least helpful to you ?", parents from this group found the newsletters to be 'informative and easy to understand', interesting. The content that were most useful included the games and tips for teaching and helping children to develop math understanding through games that encouraged their learning. In particular, these were useful as they helped parents to understand what to teach so that it would be in line with the school's syllabus and parents can help act as a reinforcement of knowledge learnt in schools. The games such as the dice game, matching and counting game with peanuts, graphing activity, number line were mentioned as being the most useful.

- How can the Newsletters be improved ? What other information would you like to receive through the newsletter ?

Parents in this group also suggested having creative worksheets or puzzles for child to practice with. Other suggestions include having more content on what was taught in the child care centre. Some parents asked for more information and guidelines for parents on where parents can go for affordable workshops or send their children for classes that are affordable. One parent commented that the standard of English was too high and would prefer to have the newsletter translated into Mandarin.

Comparing the feedback from the communication and the workshop groups, there was significantly less feedback from the former group in terms of the type of skills and knowledge that they could apply directly to their own situation. The workshop group expressed a greater sense of learning and engagement taking place as a result of the workshops and using the math kits that were sent home with the children.

The level of engagement for the communication group seemed to remain at a more superficial level as compared to the workshop groups who shared that their experiences were more positive. As mentioned in the feedback of the workshop group, it was also expressed that the direct support and help from the workshop instructors, availability of the math materials and activities and interaction with other parents as well as their own children made a difference to their awareness an understanding of what the math syllabus was like and the activities had helped greatly to impress on them the importance of helping children learn through games and using concrete materials.

The most helpful aspects of the Family Math Newsletters included the following :

1. Provided ideas for math games e.g. activities in the home, like making a number line, checklist for parents for helping your child with homework
2. Resources like the websites, books and games recommended
3. Problem solving and ideas on how parents can help children learn math - the tips/games to help my child learn math in a fun way, methods of teaching / doing math
4. A parent commented that the family math newsletters is a source of information on how to teach math at home. I hope that there will be more of such. So far the information we have received from the newsletters is quite complete – the newsletters is very good. I would like to continue receiving it

The communication group continued to request for more worksheets for their children to practice math skills as compared to the workshop groups that requested more math games and resources other than assessment and worksheets for their children. The latter group showed a greater awareness and confidence in using everyday materials and activities to help children learn math at home.

Feedback from teachers

As part of the data collection during the intervention of the workshops, participating teachers from all treatment groups were asked to keep a journal to record their anecdotal observations of the children and parents during and after the workshops. These records from the teachers' journals were helpful in providing some insight into the processes of learning and change that took place at the children's and teachers' level. Due to the workload of the teachers and their busy schedules, only four teachers from the workshop and workshop*communication groups managed to submit their journals and some of the salient points gleaned from these journals are summarized in the following section :

Teacher C from the workshop group shared her reflection of the children's interest in math soon after the workshops the math kits were introduced:

> "The children are now more participative in math activities. They also shared their experience in playing the games and activities that they borrowed home. Some of the children could do number bonds using 3 separate numbers. The children have increased their interest in math and also seeing they are sharing with the other children are rather encouraging."

She also observed some changes in the parents who participated in the workshops :

> "Some of the parents are more open and asked about the activities and the math topics taught in class. Two of the parents asked for the number line and how to teach their child using the number line."

Even her own teaching practice changed as a result of her participation in the study :

> "In order to extend children's learning process, I have made some math activities and task cards for all the children in my class and not only the children that were involved in the workshop."

Teacher M from the workshop group reflected in her journal her learning experience :

> "The training and experience provided by Ms Chan has widened my interest for teaching math in a fun way and motivated me to search for new ideas and creative ways (of teaching). I began to search for ideas by reading different approaches in integrating literacy and math.
>
> Personally, the math workshop and training has given me an insight into the different approaches to teach math in a fun way. I am using more resources and the internet to source for more ideas. I have developed more ideas as I planned more games for the children and they have taught me a lot as I listened to their comments and new ways of playing certain games."

She further shared about her observations of the parents she worked with :

> "Parents talked to each other about their child's understanding of maths and were quite worried about the Primary One (math) syllabus. As they listened and saw the demonstrations, they began to understand better how kindergarten children learn maths through play. They told me later that hearing Ms Chan's talk and demonstration was reassuring as well as good information for them. Some parents asked about their children's progress in math and saw the charts and pictures drawn by their children through the many games they played and were pleased that so many activities were given to the children.
>
> The children showed a lot more interest in math activities. One girl asked me a few times when will they have another 'math workshop'. Some expressed that the activities were 'fun, let's do it again'. I think there are changes all round with the children, parents and me. The children and I were learning from each other and through the new ideas I began to develop and have asked the children to start a math journal in which they could write and draw what they understood. Some parents were asking for more games during the weekends."

Teacher A from the workshop*communication group shared the following observations in a journal written after the 1st workshop that she had conducted :

> "The group of parents I was with was very enthusiastic; they read the activity sheet and started exploring with the materials. I explained how they would be able to use this math kit at home with their child. I

interpreted to one of the parents in mandarin what was going on and the rest of them (parents) started to help too. This activity led parents to share with one another how their child does counting.

The second group of parents was rather quiet. I explained to them how they can use another math kit at home and showed them all the materials. When I noticed that they did not look very interested, I gave them some suggestions such as the different ways to play with the math materials and they looked slightly more enthusiastic and began reading the activity sheets and one parent started asking some questions. After the session, one parent commented that he found the session to be very good and useful. Another parent (even) wanted to buy the math kit."

During the 2nd math workshop, Teacher A recorded :

"Parents were helping to guide their child during the hands on math activities. An example of an activity conducted that evening was the number bond game where a child had to find someone with a number that could add up to his/her own number to make ten. One child picked a card with three fruits printed on it and her parent facilitated her problem solving by asking her to count how many more would be needed to make ten by getting her to use her fingers to count. This activity showed that the math kits appealed to the children and they looked forward to playing the games found in the kits. Children would look forward to getting their math kits and were very excited to receive them. A few parents would ask for another kit once they have finished with one and showed an interest in wanting to help their children with the math activity at home."

On another math activity conducted during the 3rd session, teacher A noted :

"An example where a parent was observed to be facilitating his child with a number line activity where a child was required to count on. This child had some difficulties counting on from a number and was always starting at one. His parent saw this and helped him by getting him to count from where he last stopped and after a few attempts, this child was able to count on independently. I then recommended parents some of the math kits that involved the use of the number line and they were very keen to try them.

After bringing the math kit home and doing it with their child, some parents shared that their child looked forward to getting a new kit as their experience with the previous one was great. These parents felt that one of the reasons why their child was so enthusiastic was because the materials in the kit were 'very concrete' and this made learning math fun for the child. Some parents also expressed more interest in finding out how mathematical concepts are taught in class so that they can reinforce the concepts with their child at home in a similar way."

Another teacher P from the workshop*communication Group shared the following in her journal :

> "Most parents found that the workshops have given them great opportunity to know more about the current Primary One math syllabus and are more aware of the topics taught. Some parents even began to search for old toys to use to teach their child different math concepts at home"

She also shared her observations of the children's innovative ideas at creating their own math games using the manipulatives in the math corner:

> "Some children have been playing the different math kits in their math corner and I have seen them re-creating the games into different math concepts e.g. They used the groundnuts to sort them into different groups according to the shape. More children were observed to bring in books on math e.g. Story books and activities that they have done at home with their parents.
>
> Using some ideas from the math kits, I have created several different activities for the children to play with in the math corner e.g. number bond games using different food items, sorting of food pictures and comparing more and less using the manipulative counters such as lego bricks and 'kutti kutti'."

Summary of Findings

From the feedback given by both parents and teachers, both the parent workshops and the newsletters were well received.

A high percentage (88%) of parents agreed that because of the workshops they attended, there would be able to make use of materials at home to help their child learn (math) and that the workshops have helped them with their parenting skills (80%). Statements from parents who attended the workshops lend further support to these high ratings, as they commented on how they have learned many helpful teaching strategies to help their children learn math at home. Their statements indicate that they had benefited more in terms of their knowledge and 'practical skills' of how they could make use of everyday materials to support their children's math learning at home, and have also broadened their understanding of how to teach their children math. Parents were observed to interact and take on the role of a 'teacher' with their children during the parent education workshops in explaining and encouraging their child to solve mathematical problems such as simple addition using number bonds, number sequencing, patterning etc. The modeling and facilitation provided by the teachers during the workshops also played an important role in helping parents to observe and apply the new knowledge towards using materials to support their child's math learning.

With the new knowledge and skills gained from the workshops on how to support children's math learning, these parents also expressed positive statements about their own learning and confidence in teaching their children math concepts. From parents' positive statements, combined with the provision of the math kits sent home for them to use as teaching activities with their children, the parents have become more engaged in their home involvement in helping their children with learning math at home.

Parents who received only the newsletters, on the other hand, expressed fewer positive statements about their own learning and confidence in helping their children with math as compared to parents from the group who received both the newsletters and who attended the workshops. These parents also requested more worksheets as compared parents who attended the workshops who asked for more math-related games and activities.

From the feedback given by the parents, there appears to be empirical support that the parent math workshops had a more positive effect on parents' learning and understanding of how to help their child learn math at home as compared to the newsletters alone. This could be a result of the impact of parents' learning from the teachers' demonstration and facilitation during the workshops as well as the opportunities for them to explore and try out various math kits and activities together with their children in a conducive and accepting environment, created by both the teachers and the availability of the various math materials.

The next two chapters will present the quantitative findings that address the hypotheses of this study, and will also draw on the findings reported in this chapter to provide further insight and explanation into the findings.

5. FINDINGS AND INTERPRETATIONS: CHILDREN'S MATH ACHIEVEMENT

Introduction

This chapter presents the data and findings related to the children's math achievement. The first part of the chapter recaps the experimental hypotheses put forward, The second part of the chapter presents a description of the general profile of the groups at the beginning of the experiment. The third part is dedicated to testing the hypotheses and the statistical analysis of the experiment. The inferential statistical analysis of the data using ANCOVA to compare the differences in the group means for children's math outcome will be presented. This section is further divided into two parts, (i) analysis of the gain math scores for all children and (ii) analysis of the gain math scores for children according to their banded premath scores.

Hypotheses

The key research question guiding this study was :

Does a single type (parent workshop or communication) of school initiated involvement or a combination of types of school initiated Involvement (workshop and communication) help to improve children's math achievement .

The experiment adopted a pre test, post test design, randomized two-factor factorial experiment and the experimental conditions are summarized in the Table 5-1 :

Level of Independent factors	No Workshop	Workshop
No Communication	Group 1	Group 2
Communication	Group 3	Group 4

Table 5-1 A randomized, two-factor experiment on the effects of communication and Workshop on children math outcome

The conditions allowed the investigation of the effects of the communication and workshop condition and a combination of these two conditions on the children's math achievement.

For each of the treatment conditions, children were expected to demonstrate some gains in the math achievement. However, each treatment condition was expected to influence children's gains in math scores to different degrees.

Students in the treatment groups were expected to perform better than those in the control group. The desired outcomes of the treatment were as follows :

1. Greater improvement in children's math achievement for the treatment groups as compared to the control group.

2. The largest improvement in math achievement was expected in the workshop*communication group compared to the other two experimental treatments and control group.

The rationale of the factorial ANOVA tests for the presence of main effects of each factor considered separately, and interactions between the factors. The analysis of a two-factor ANOVA actually involves three distinct hypothesis tests.

Specifically the two-factor ANOVA will test for :

1. The mean difference between levels (none and present) of the first factor, communication
2. The mean difference between levels(none and present) of the second factor, workshop
3. The mean difference between levels (none and present) of the combination of the two factors, communication and workshop

The analysis appropriate for the data is a two-factor independent measures ANOVA and ANCOVA. It is a two-factor ANOVA because there are two independent variables (communication and workshop); it is an independent measures ANOVA because the samples come from independent populations[24].

The purpose of including covariates in the ANOVA is to eliminate the bias of a variable that could confound the results, i.e. variables that vary systematically with the experimental manipulation. In this case, the pre-test math score was selected as the covariate.

Null Hypotheses

The first two hypothesis tests for the main effects of the two factors and the null hypothesis for main effects is that there are no differences between the levels of the factors (i.e. $H_0 : \mu_{\text{No Communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{Workshop}}$)

The third hypothesis test is the test of the effects of the combination of the two factors together. The null hypothesis for the combined factors is that there is no difference between the levels of factors (i.e. $H_0 : \mu_{\text{No Workshop*Communication}} = \mu_{\text{Workshop*Communication}}$), and the combination of the two factors will have no effect on the children's math outcome.

---

[24] The sample was drawn from 21 different child care centres managed by the same organization

To answer the above questions, the following data were collected :

Measures /data	Analysis
Group means of gain scores (post – pre test scores) of : 1. Children's math score 2. Parent Confidence 3. Parent Encouragement 4. Parent Home Involvement	1. Descriptive statistics of pre, post and gain scores 2. Factorial ANOVA to compare the differences in group means for the different dependent variables across the experimental groups 3. Effect sizes of group differences
Feedback from parents and teachers gathered from evaluation forms and journals	Analyze feedback according to themes : • Knowledge and skills gained from the workshops and newsletters

Exploratory analysis of the Experiment

An exploratory analysis of the data prior to hypotheses testing was performed. This exploratory analysis helped to create a profile of the groups and to make initial observations of the groups' math scores before and after the treatment.

Children's gain math score was a key dependent variable. The criterion-referenced test was divided into 10 sub-sections comprising a total of 58 different items which when answered correctly, would be awarded 1 mark each. Hence, the highest mark that each child can score is 58 and the lowest, would be 0.

The alpha coefficient for the math assessment (all items) based on the pre-test and post test, was 0.92 and 0.94, respectively. The coefficients for the different sub-sections of the pre and post math test are summarized in tables 5-2 and 5-3.

Table 5-2 Reliability Statistics for pre math test – Cronbach alpha

Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All items	.920	.931	57
Rational Counting [25]	.610	.606	5
Number sequencing	.958	.961	6
Missing Numbers	.919	.927	10
Sequencing	.861	.863	4
Greater /Lesser	.902	.902	3
Graphing	.395	.453	4
Addition	.870	.865	8
Patterns	.611	.610	3
Counting On /Back	.918	.917	6
Word Sums	.709	.708	8

Table 5-3 Reliability Statistics for post math test– Cronbach alpha

Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
All items	.941	.936	58
Rational Counting	.646	.743	6
Number sequencing	.919	.923	6
Missing Numbers	.877	.875	10
Sequencing	.828	.830	4
Greater /Lesser	.566	.610	3
Graphing	.454	.504	4
Addition	.831	.831	8
Patterns	.649	.678	3
Counting On /Back	.951	.950	6
Word Sums	.808	.795	8

[25] The component variable item 4 of rational counting (RC4) has zero variance and was removed from the scale, Hence, the total number of items for the pre-test was shown as 57 instead of 58.

The Guttman split-half Coefficient for the pretest and post test was 0.59 and 0.79 respectively (Table 5-4 and 5-5).

Table 5-4 Reliability Statistics (Pre test) – Split Half

Cronbach's Alpha	Part 1	Value	.913
		N of Items	28(a)
	Part 2	Value	.889
		N of Items	29(b)
	Total N of Items		57
Correlation Between Forms			.466
Spearman-Brown Coefficient	Equal Length		.635
	Unequal Length		.635
Guttman Split-Half Coefficient			.587

Table 5-5 Reliability Statistics (Post test) – Split Half

Cronbach's Alpha	Part 1	Value	.886
		N of Items	29(a)
	Part 2	Value	.916
		N of Items	29(b)
	Total N of Items		58
Correlation Between Forms			.707
Spearman-Brown Coefficient	Equal Length		.828
	Unequal Length		.828
Guttman Split-Half Coefficient			.789

The total score of the assessment is expressed as the number of items answered correctly, the focus being 'what' the children were able to do in terms of standards of proficiency within the selected domains. Figures 5.23 to 5.26, show that the distribution of the pre test math scores were skewed slightly towards the higher end of the marks (maximum of 58) for all groups. This is not surprising as most criterion-referenced tests tend to result in a skewed distribution (McMillan & Schumacher, 2001).

In order to maintain the internal validity of the pre and post test math assessment, the items in the post test could not be changed too much in order to maintain consistency in the standard between the pre-test and post test. Also, if more items were to be added to the post test, this could have made the test too long and tedious for the children. Given their young age, this in turn could have affected their performance in the assessment.

Furthermore, by the time the investigator discovered the presence of the ceiling effect, which was not apparent in the pilot, it was already too late to re-administer a different post test as some of the children had already withdrawn from the centres and have entered primary school.

Preparation for Data Analysis

SPSS (version 12.0) was used to perform the exploratory data analysis, descriptive analysis and inferential analysis of the data. A significance level of 5% was adopted in the analysis.

Categorising Data for Analysis Purposes

Some of the data collected were regrouped into a smaller number of categories. This categorization was necessary for group comparisons, analysis of frequencies and other types of analysis. The categories are described below :

- Children's Banded Math scores

  The children's math scores (pre-test) were divided into three sub-groups (bands) based on their pretest math scores: 1 = Low (n=88, 46 marks and less) , 2 = Medium (n = 78, 47-52 marks) and 3 = High (n= 77, 53-58 marks).

- Definition of Math Achievement

  To minimize any problems in the analysis resulting from initial differences found in the groups, children's math achievement was measured using the absolute and relative differences between the post-test and pre-test math scores as follows :

1. the **absolute difference** between the post-test and pre-test math score was calculated by :
    a. Δmath score = (Post test score) – (Pre test score)
2. the **relative difference (percentage math gain)**, calculated by using the formula:

$$\frac{\Delta \text{ score}}{\text{score}} = \frac{(\text{Post test score}) - (\text{Pre test score})}{(\text{Pre test score})} \text{ X } 100$$

- Parents' Education Level
  The original four categories of parent education level (1 =Primary, 2=Secondary, 3=Diploma, 4=Tertiary) were re-grouped into two groups : 1=Primary/Secondary and 2=Tertiary/Diploma) so as to pre-empt the small n in the different groups
- Treatment conditions were dummy coded into three groups for further ANOVA analyses and hypotheses testing :
    a. Groups with and without the communication condition
    b. Groups with and without the workshop condition

Table 5-6 General profile of the different experimental and control groups

		child gender		Total
Method		female	male	
Control	Count	24	24	48
	% within Method	50%	50%	100%
	% of Total	9%	9%	19%
Workshop	Count	38	31	69
	% within Method	55%	45%	100.0%
	% of Total	15%	12%	27%
Communication	Count	39	36	75
	% within Method	52%	48%	100%
	% of Total	15%	14%	29%
Workshop*Communication	Count	35	32	67
	% within Method	52%	48%	100.0%
	% of Total	14%	12%	26%
Total	Count	136	123	259
	% within Method	53%	47%	100%
	% of Total	52%	48%	100%

The subjects consisted of 259 children, where 53% were girls and 48% were boys. The number of boys and girls within each of the groups were fairly evenly distributed (Figure 5-1).

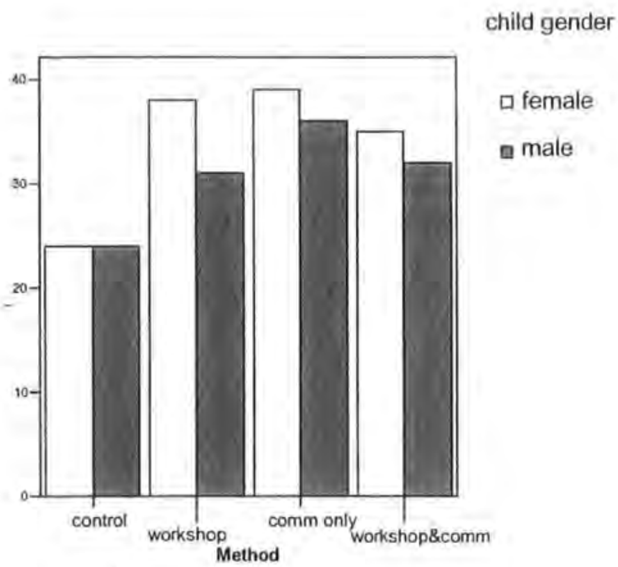


Figure 5-1 Bar chart of the distribution of males and females by experimental groups

Testing Hypotheses Related to Children's Math Gains

The experimental hypothesis was that the increase in math gain would be higher for the treatment groups than that of the control group. To test the hypotheses, I had at my disposal the following sources of information :

1. Descriptive values of Pre, Post and Gain math scores
2. Absolute and relative differences of the post- and pre-tests scores (Δmath score and Δ score / score)
3. Feedback from parents and teachers

Descriptive Analysis of Pre, Post and Gain Math Scores

This section will present the pre, post and gain math scores of the different groups. Table 5-7 shows a summary of these scores and from this Table, we observe that :

The lowest pre-test math score were found in the control (M=45, SD=8.3) and communication group (M=45.5, SD=10. 422), while the highest was found in the workshop group (M=49, SD= 6.9). It is noted that the control group had a lower mean for the pre test math score as compared to the other three treatment groups. This was unexpected as the children were randomly assigned to the experimental groups, and the investigator had no prior knowledge of their different abilities and backgrounds before they were assigned to the treatment groups.

The lowest post test math score was found in the communication group (M=48.3,SD=10.97). The highest post test math score was found in the workshop*communication group (M=52.6,SD=6.4), followed by the workshop group (M=51.02,SD=7.04) and control group (M=50.28, SD=7.3).

Table 5-7 Children's pre, post and gain math scores

	Method	N	Mean	Median	Variance	Std. Deviation	Skewness	Kurtosis
pre-math scores	Control	40	45.50	46	68.564	8.28	-.847	.947
	Workshop	66	49.00	51	48.123	6.93	-.812	.392
	Communication	66	45.55	48	108.621	10.42	-1.221	.985
	Workshop*Communication	63	47.67	51	88.000	9.38	-1.761	3.510
post-math scores	Control		50.28	52	52.871	7.27	-1.345	1.729
	Workshop		51.02	53	49.554	7.03	-1.652	3.688
	Communication		48.26	52	120.502	10.97	-1.342	.711
	Workshop*Communication		52.56	55	40.767	6.38	-1.725	2.714
Gain math score	Control		4.7750	4.5	23.153	4.811	.420	1.612
	Workshop		2.0152	1.0	30.261	5.501	.362	.290
	Communication		2.7121	2.5	27.777	5.270	-.432	.602
	Workshop*Communication		4.8889	4.0	38.068	6.169	1.089	1.402

Children in the workshop*communication group had the highest post test math score (52.6 marks) as compared to the other three groups (Table 5-7).

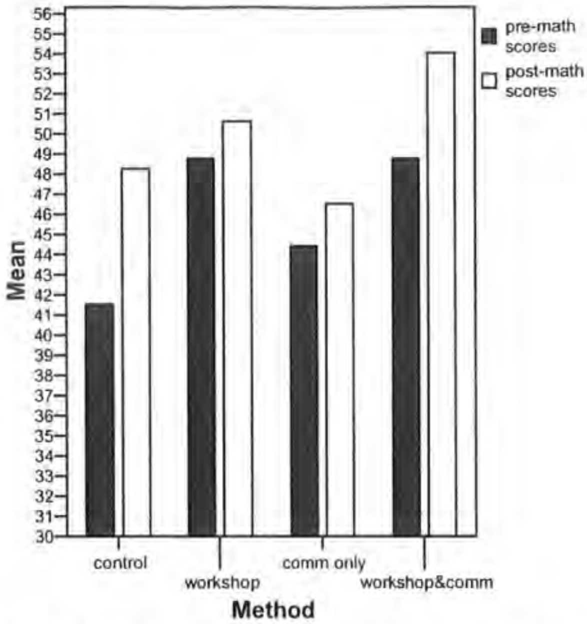


Figure 5-2 Bar chart of Children's pre- and post- test math scores

The pre and post test math scores are presented in Figures 5-2 and 5-3. The children generally performed better in the post-test across the four groups, as seen in Fig 5-2. Fig 5-3 shows higher median post math scores compared to the pre test math median scores across all four groups. However, the post test math scores (median and upper quartile) for the workshop*communication, workshop and communication groups were higher than the control group.

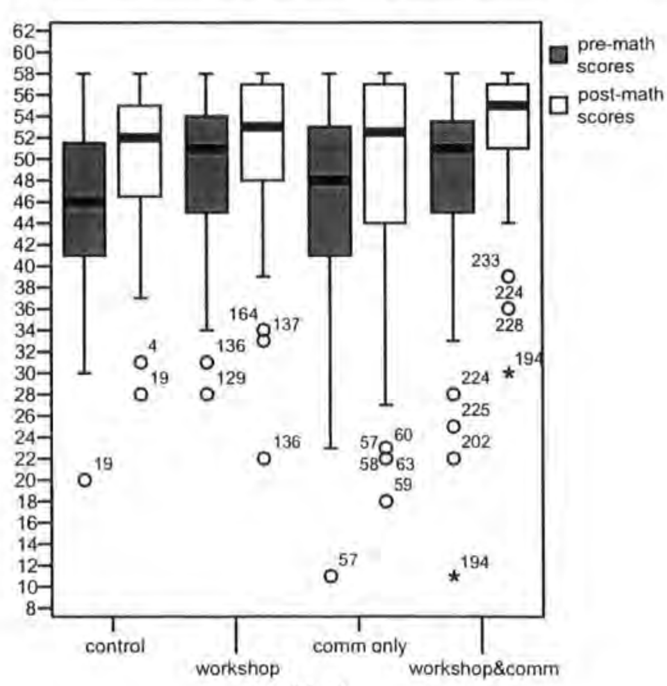


Figure 5-3 Box plots of Children's pre- and post- test math scores

The median post test math scores for the communication, workshop and control groups was similar (52 and 53 marks). The control group showed the lowest median and upper quartile marks as compared to the other three experimental groups.

The maximum marks attained in the post-test by the three treatment groups were also closer to the full mark of 58, as compared to the control group.

Gain Math Scores

This section presents the distribution of the math gain across all groups. As shown in Fig 5.4 the gain math score is normally distributed (all children).

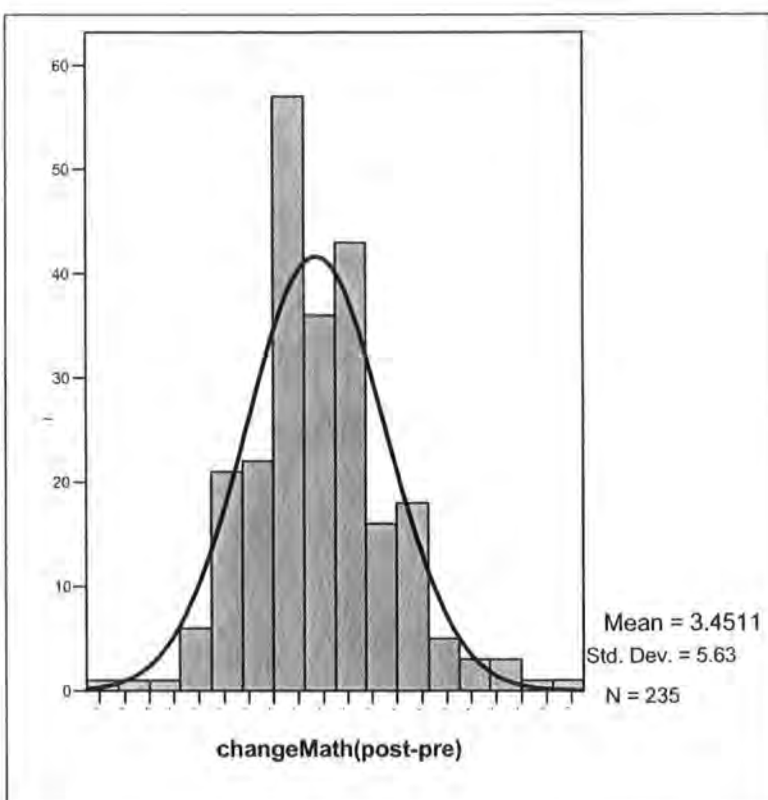


Figure 5-4 Distribution of Gain Math scores (all children)

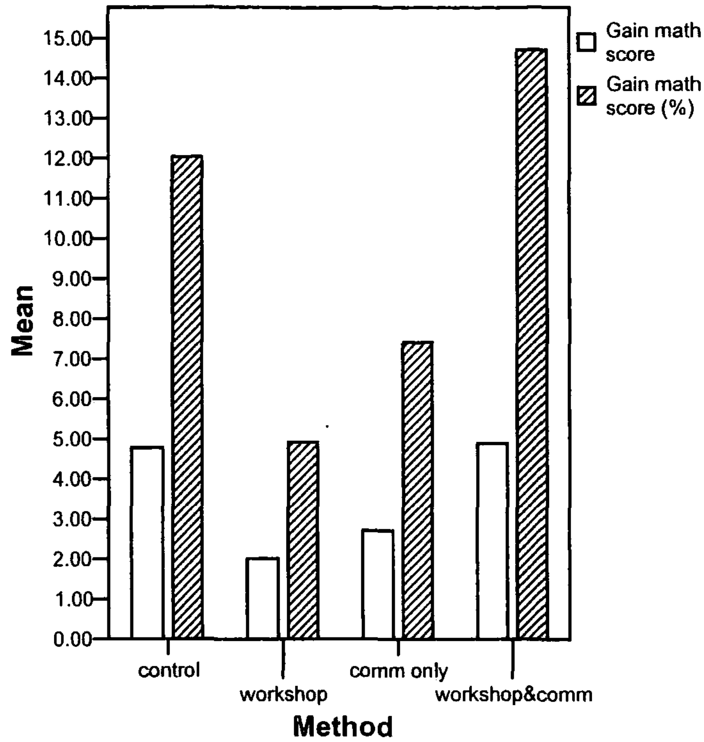


Figure 5-5 Bar Chart of Gain Math and Gain Math (%) (All children)

Children in the workshop*communication group scored highest in Gain Math and Gain Math (%) scores (Figure 5-5).

The next largest gain is seen in the control group. This was unexpected, because it was predicted that the children in the treatment groups would score higher compared to the control group (Table 5-8). Some possible reasons for this could be due to a combination of factors :

1. A lower pre-test math score was found in the control group, compared to the other three treatment groups
2. The control group had a smaller number of children participating in the study, resulting in a narrower range of marks
3. A ceiling effect of the math assessment that may have resulted in smaller gain scores for the treatment groups, and a higher gain score for the control group. This can be attributed to the test not having sufficient hard items to balance the easy items

4. Effects of the treatment (parent education workshops and communication) were weak

Table 5-8 Gain math scores of different groups (All Children)

Method		Gain math score (%)	Gain math score
control	N	40	40
	Mean	12.04	4.77
	Std. Deviation	13.73	4.81
workshop	N	66	66
	Mean	4.92	2.02
	Std. Deviation	13.99	5.50
Communication only	N	66	66
	Mean	7.42	2.71
	Std. Deviation	17.93	5.27
Workshop*Communication	N	63	63
	Mean	14.72	4.89
	Std. Deviation	27.73	6.17
Total	N	235	235
	Mean	9.46	3.45
	Std. Deviation	19.86	5.63

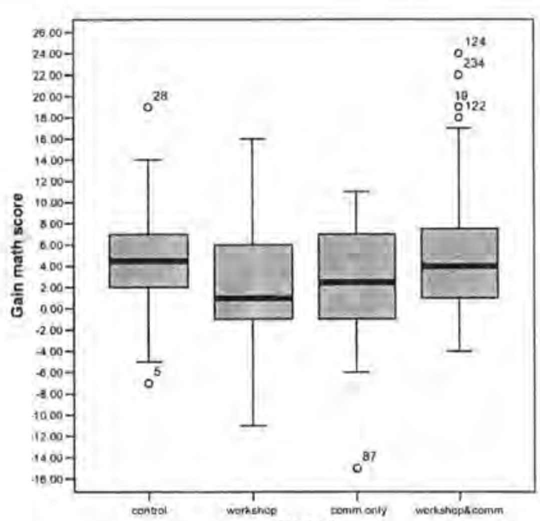


Figure 5-6 Box plots of gain math score across groups

Closer examination of the outliers (Figure 5-6) which were from the workshop and communication groups confirmed that these children, (outliers in the post test scores) scored among the lowest in the pre-test and did much better in the post test. They also did not attend tuition classes, thus ruling out that there were likely to be other attributing factors that could have helped the children improve in their math achievement. This suggests that the intervention could have been the main cause of the higher score. Likewise, a check on the types of enrichment classes which some of the other children attended during the time of this study were not related to the subject math.

It was also unlikely that the children could have been influenced by their peers whilst taking the test as they were seated individually and the administration of the assessment was also supervised by the investigator.

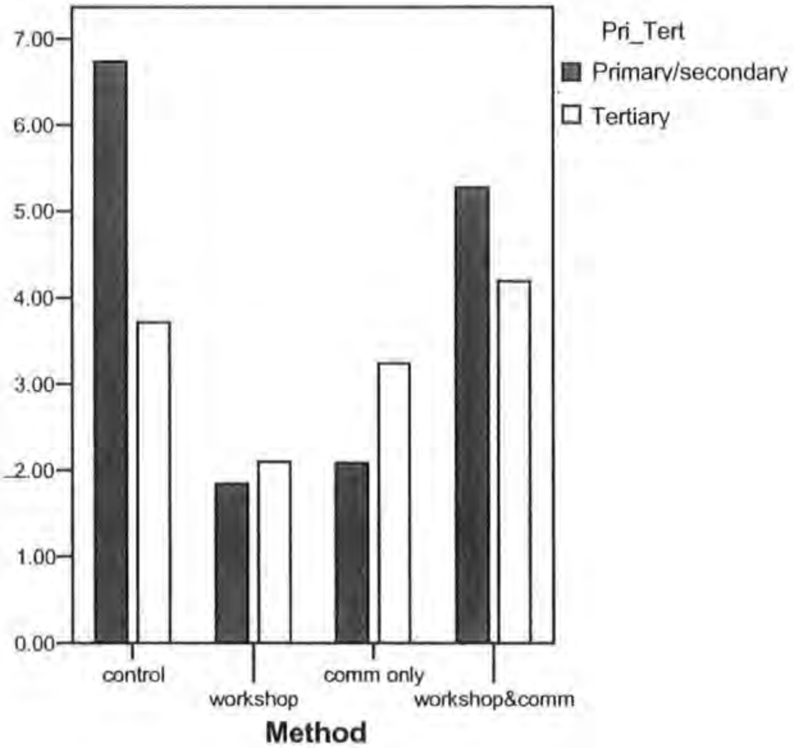


Figure 5-7 Bar charts of Gain Math score by Parent Education Level

Children of both Primary/secondary and Tertiary educated parents scored highest in the control and workshop*communication groups (Figure 5-7).

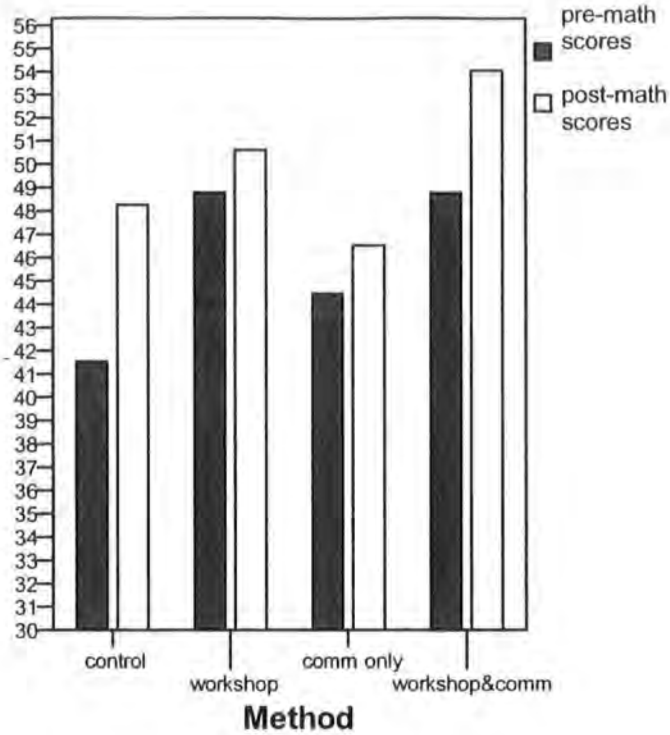


Figure 5-8 Bar chart of pre and post math score (Parent with primary/secondary education)

Children of primary/secondary educated parents in the workshop*communication group also had the highest post test math and gain math score (Fig 5-8).

- Math Scores by Gender

A summary of group means of children's math scores (pre, post and gain math) by gender is presented in Table 5-9.

For both the workshop and workshop*communication groups, the girls did better than the boys in terms of the median pre-test math score.

Table 5-9 Pre,Post and Gainmath scores by gender by experimental groups

Statistics	Method	pre-math scores			post-math scores			gain math (post-pre)[26]		
		child gender			child gender			child gender		
		female	male	Total	female	male	Total	female	male	Total
N	Control	19	21	40	24	24	48	19	21	40
	Workshop	37	30	67	37	31	68	36	30	66
	Communication	37	35	72	35	32	67	35	31	66
	Workshop* Communication	33	31	64	35	31	66	33	30	63
	Total	126	117	243	131	118	249	123	112	235
Mean	Control	42.74	48.00	45.50	49.75	50.75	50.25	6.26	3.43	4.78
	Workshop	49.49	48.17	48.90	51.41	50.87	51.16	1.61	2.50	2.02
	Communication	44.65	46.00	45.31	48.17	48.50	48.33	3.77	1.52	2.71
	Workshop* Communication	48.52	46.84	47.70	52.60	52.45	52.53	4.27	5.57	4.89
	Total	46.79	47.14	46.96	50.56	50.62	50.59	3.66	3.22	3.45
Std. Deviation	Control	9.13	6.70	8.28	8.03	6.41	7.20	4.75	4.57	4.81
	Workshop	6.21	7.79	6.94	7.56	6.35	6.99	4.61	6.46	5.50
	Communication	10.81	10.97	10.83	10.37	11.63	10.91	5.03	5.36	5.27
	Workshop* Communication	10.31	8.19	9.31	7.10	5.45	6.33	5.51	6.85	6.17
	Total	9.53	8.74	9.14	8.46	8.00	8.23	5.18	6.09	5.63

The post test score for both boys and girls in the workshop group was similar. The math scores (pre, post and change) by gender are presented in Figures 5-9 and 5-10 :

[26] Due to missing data, the mean change math scores computed by SPSS may show discrepancies

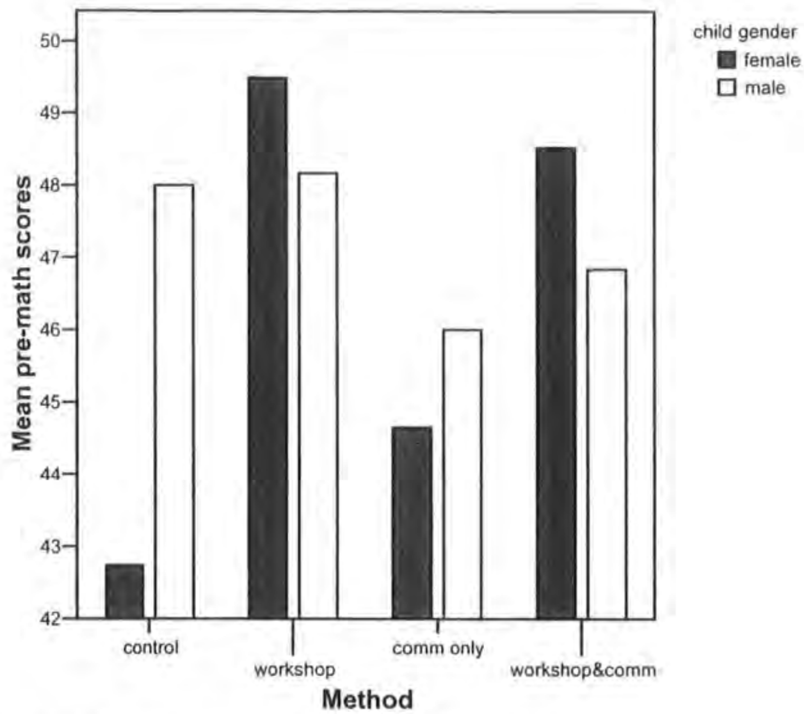


Figure 5-9 Bar charts of pre test math scores by gender

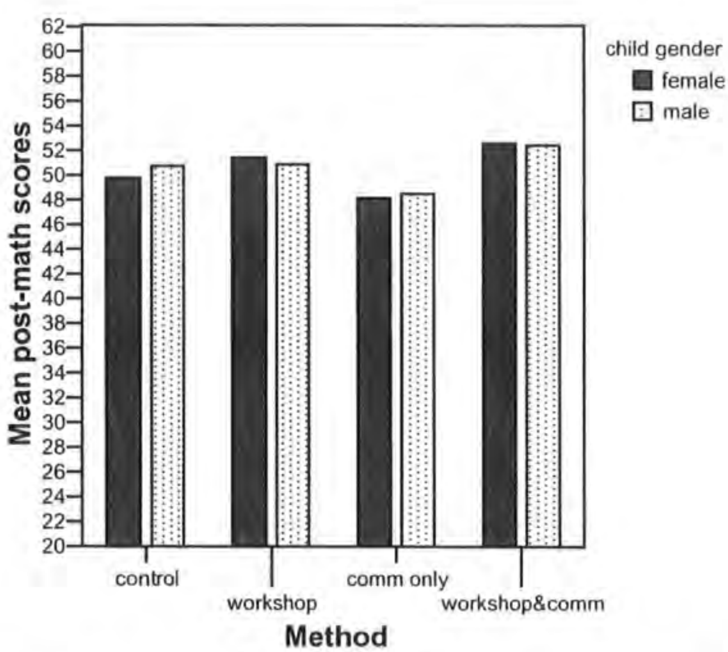


Figure 5-10 Bar charts of post test math scores by gender

The girls in the workshop and workshop*communication groups fared better (higher mean scores) than the boys in the pre test. There was little difference between the boys and girls in the communication group and the boys did better than the girls for the control group.

From the bar graphs (Fig 5-11), the boys in the control group and communication groups performed slightly better than the girls in the pre test math score.

Children across the experimental groups showed improvement in the post math score. However the girls continued to outperform the boys in the gain math scores for the control and communication groups and the boys performed slightly better than the girls in the workshop and workshop*communication groups (Fig 5-11).

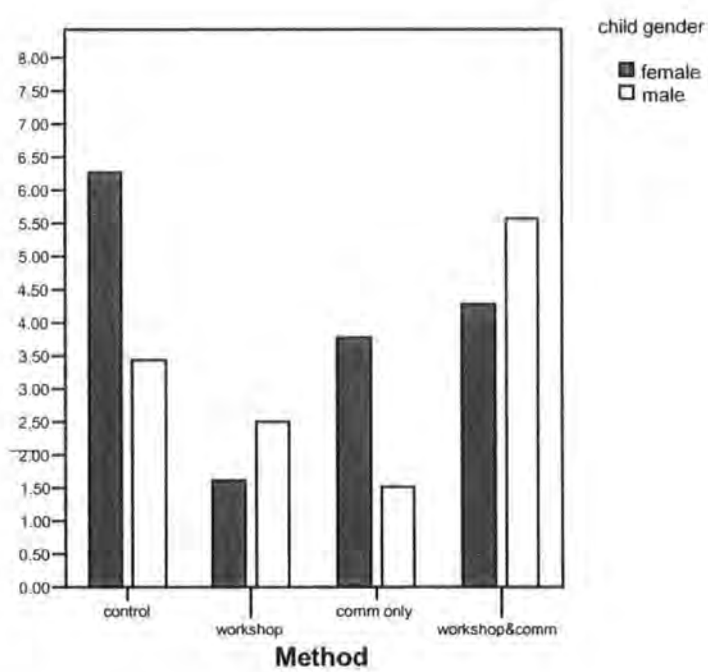


Figure 5-11 Bar charts of gain math scores by gender

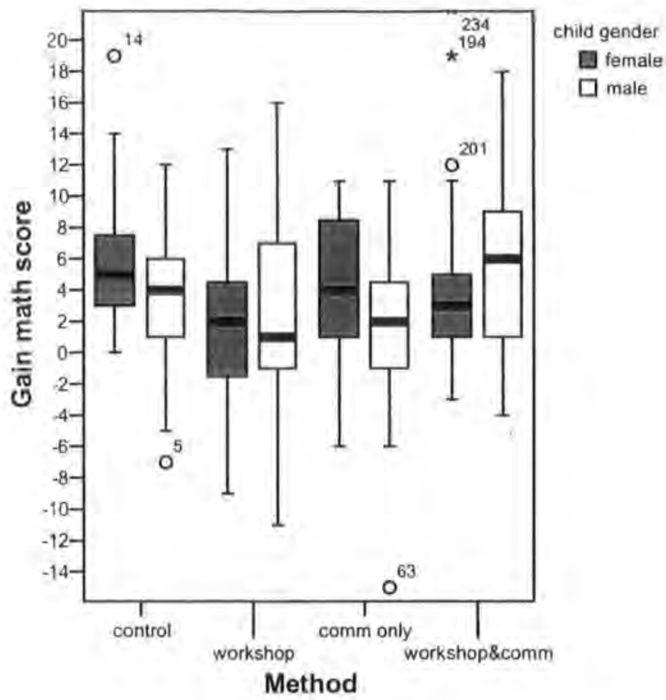


Figure 5-12 Box plots of Gain Math scores by gender

Among the boys, those in the workshop*communication group had the highest gain math (5.57) scores and among the girls, those in the control group had the highest gain math score (6.26), followed by those in the workshop*communication group (4.26). (Table 5-10).

Table 5-10 Pre, Post and Gain math scores by banded (1,2,3) and experimental groups

Statistics	Method	**pre-math scores**				**post-math scores**				**gain math(post-pre)**			
		pre-math scores (Banded)				pre-math scores (Banded)				pre-math scores (Banded)			
		1	2	3	Total	1	2	3	Total	1	2	3	Total
N	Control	21	10	9	40	21	10	9	40	21	10	9	40
	Workshop	24	18	25	67	23	18	25	66	23	18	25	66
	Communication	24	29	19	72	23	24	19	66	23	24	19	66
	Workshop*Communication	19	21	24	64	19	20	24	63	19	20	24	63
	Total	88	78	77	243	86	72	77	235	86	72	77	235
Mean	Control	39.43	49.80	54.89	45.50	46.43	53.00	56.22	50.28	7.00	3.20	1.33	4.78
	Workshop	41.33	49.72	55.56	48.90	45.52	51.67	55.60	51.02	4.22	1.94	.04	2.02
	Communication	32.96	49.10	55.11	45.31	37.78	52.42	55.68	48.26	3.87	3.29	.58	2.71
	Workshop*Communication	36.32	49.90	54.79	47.70	47.16	53.65	55.92	52.56	10.84	3.75	1.12	4.89
	Total	37.51	49.55	55.13	46.96	44.03	52.65	55.79	50.53	6.27	3.07	.66	3.45
Std. Deviation	Control	6.53	1.81	2.20	8.28	7.45	4.85	2.11	7.27	4.54	4.52	3.00	4.81
	Workshop	4.78	2.08	1.85	6.94	8.26	4.78	2.10	7.04	7.89	3.92	2.32	5.50
	Communication	9.95	1.86	6.53	10.83	12.18	4.34	2.85	10.98	7.20	4.31	2.50	5.27
	Workshop*Communication	9.30	1.67	1.82	9.31	8.27	3.84	2.69	6.38	6.71	4.22	2.74	6.17
	Total	8.42	1.86	1.85	9.14	9.92	4.37	2.45	8.34	7.17	4.18	2.58	5.63

Table 5-11 Gain math scores by Parent Education level (All children)

Method	Pri_Tert	Gain math score			Gain math score (%)		
		N	Mean	Std. Deviation	N	Mean	Std. Deviation
Control	Primary/secondary	19	6.74	4.20	19	17.95	14.60
	Tertiary	14	3.71	3.27	14	7.76	7.27
	Total	33	5.45	4.07	33	13.63	12.94
Workshop	Primary/secondary	32	1.84	5.90	32	4.70	15.83
	Tertiary	31	2.10	4.94	31	4.98	11.84
	Total	63	1.97	5.41	63	4.84	13.90
Comunication	Primary/secondary	36	2.08	6.01	36	6.43	22.04
	Tertiary	25	3.24	4.25	25	7.61	11.10
	Total	61	2.56	5.35	61	6.91	18.25
Workshop*Communication	Primary/secondary	22	5.27	6.68	22	14.62	25.04
	Tertiary	36	4.19	5.49	36	10.65	15.22
	Total	58	4.60	5.94	58	12.16	19.42
Total	Primary/secondary	109	3.47	6.11	109	9.58	20.36
	Tertiary	106	3.29	4.82	106	7.90	12.53
	Total	215	3.38	5.50	215	8.75	16.94

Table 5-12 Gain math scores by Parent Education level (Band 1 Pre-math)

		Gain math score			Gain math score (%)		
Method	Pri_Tert	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Control	Primary/secondary	14	7.07	4.55	14	20.19	16.09
	Tertiary	4	7.25	3.69	4	15.94	8.21
	Total	18	7.11	4.27	18	19.25	14.60
Workshop	Primary/secondary	11	3.64	8.95	11	10.07	25.38
	Tertiary	10	5.50	6.65	10	13.60	16.65
	Total	21	4.52	7.80	21	11.75	21.21
Comunication	Primary/secondary	14	3.00	8.37	14	11.78	33.92
	Tertiary	5	5.20	5.97	5	15.55	19.03
	Total	19	3.58	7.71	19	12.77	30.24
Workshop*Communication	Primary/secondary	4	15.75	6.65	4	53.75	38.95
	Tertiary	13	8.38	5.91	13	23.13	17.93
	Total	17	10.12	6.70	17	30.34	26.55
Total	Primary/secondary	43	5.67	8.01	43	17.99	29.17
	Tertiary	32	6.84	5.86	32	18.07	16.64
	Total	75	6.17	7.15	75	18.02	24.47

- Children's Math Scores (Banded)

Since there is a ceiling effect found in the children's post test math scores, it would be appropriate to explore further the children's math scores according to the banded (pre test math) subgroups. To recap, the children's math scores were further divided into three sub-groups (bands) based on their pre test math scores: 1 = Low (46 marks and less) (n= 88), 2 = Medium (47-52 marks)(n = 78) and 3 = High (53-58 marks) (n=77). The re-grouped gain math scores are shown in Table 5-10.

The following box plots and bar charts show the distribution of the pre and post math scores of the children according to the three bands :

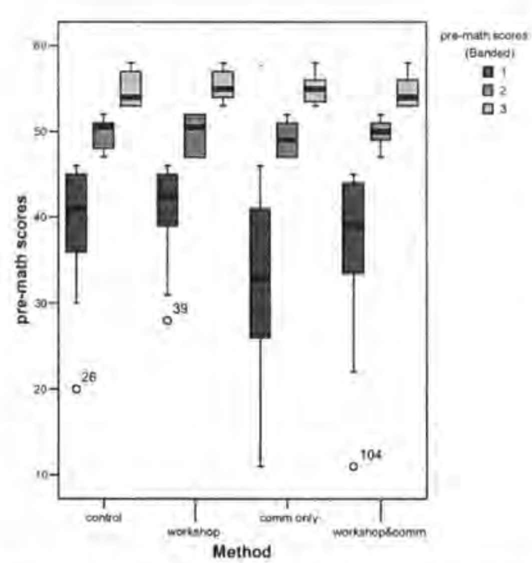


Figure 5-13 Box plots of premath scores by Bands (1,2,3)

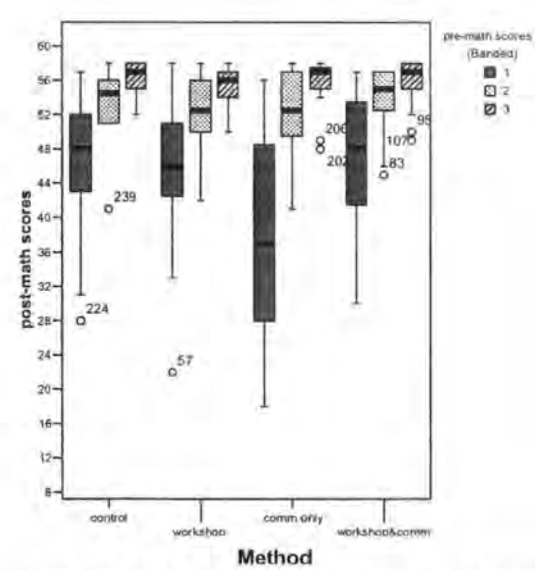


Figure 5-14 Box plots of post math scores by Bands (1,2,3)

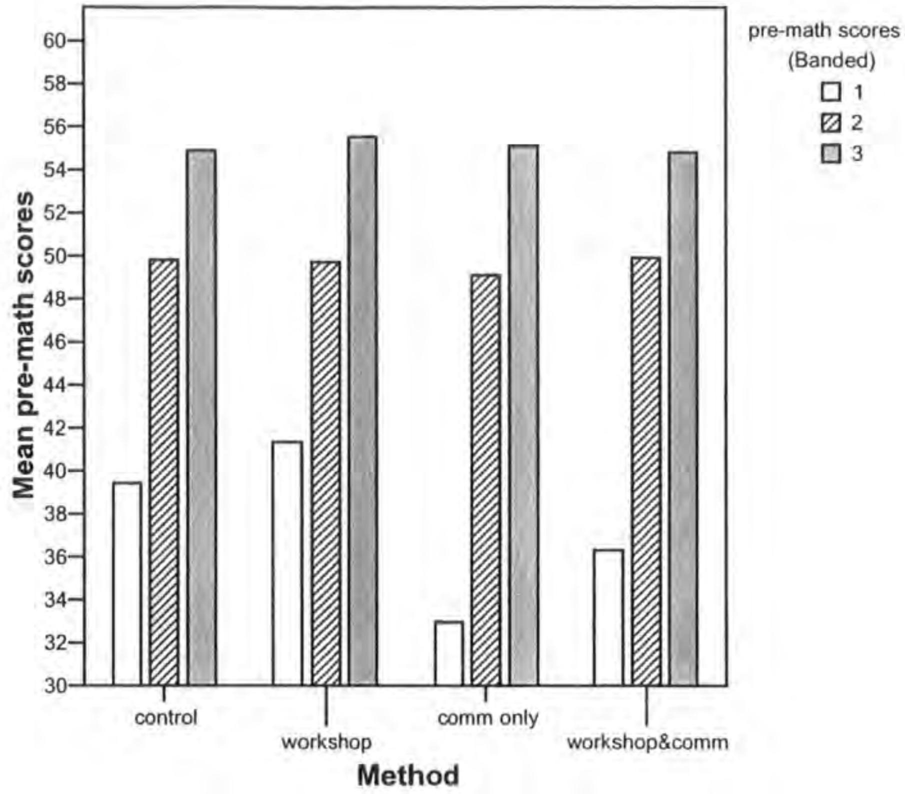


Figure 5-15 Bar charts of premath scores by Bands (1,2,3)

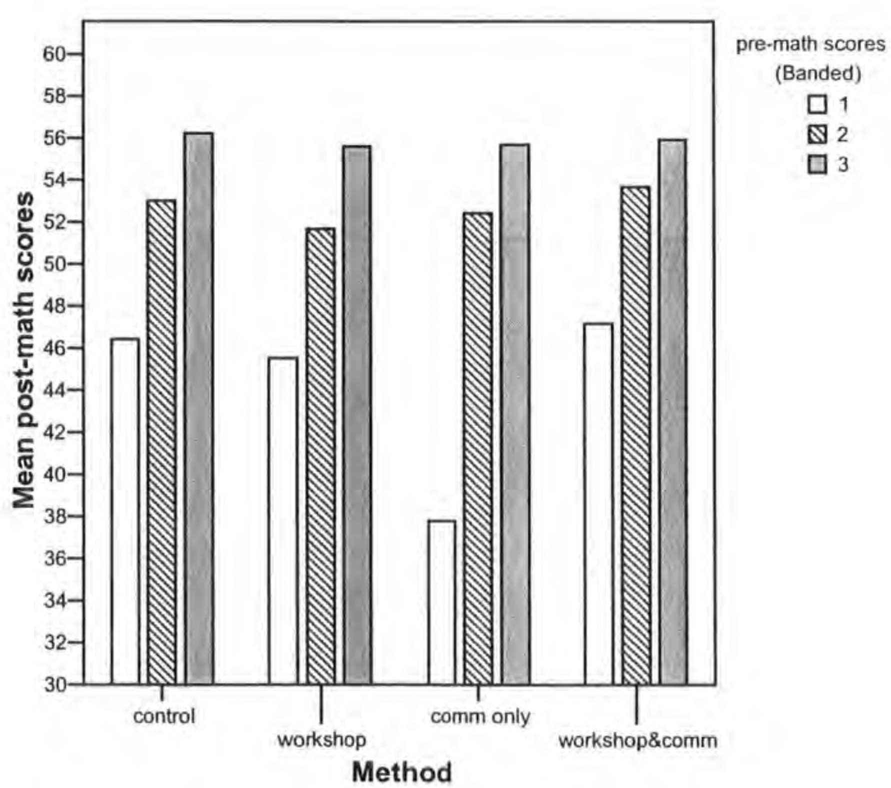


Figure 5-16 Bar charts of post math scores by Bands (1,2,3)

The pre test math scores for children within the Bands 2 (medium) and 3 (high) appear to be almost the same across the different experimental groups. For the band 1 (low) children, the lowest pre test math group mean was found in the communication group (M=32.96, SD=9.95), followed by the workshop*communication group (M=36.32, SD=9.3) (Table 5-10). The highest pre test math score was found in the workshop*communication group.

The communication group (Band 1) scored lowest in the post test (M=37.78, SD=12.18). Within the Band 1 group, the workshop*communication group scored the highest in post test (47.16, SD=8.27) followed by the control group (M=46.43,SD=7.45) (Fig 5-16). The gain math scores for children in Band 1 group are summarized in the Table 5-13.

Table 5-13 Gain Math scores of Band 1 children

Method		Gain math score (%)	Gain math score
Control	N	21	21
	Mean	18.77	7.00
	Std. Deviation	14.57	4.54
Workshop	N	23	23
	Mean	10.95	4.22
	Std. Deviation	21.09	10.95
Communication	N	23	23
	Mean	13.34	3.87
	Std. Deviation	27.86	7.20
Workshop*Communication	N	19	19
	Mean	38.11	10.84
	Std. Deviation	41.12	6.71
Total	N	86	86
	Mean	19.50	6.27
	Std. Deviation	28.84	7.17

The Band 1 children (low) showed the largest improvement in terms of the gain math score across the four experimental groups, perhaps due partly to a regression to the mean effect[27], with the highest gain occurring in the workshop*communication group. (Mean = 10.84, SD = 6.7) (Table 5-13 and Figure 5-17). Gains in the other two treatment groups were lower than that of the Control group. This suggests that the workshop*communication treatment had an impact on the children's math gain especially for the Band 1 subgroup.

Among the Band 2 children, those in the workshop*communication group had the largest gain math score. Among the Band 3 children, those in the Control group had the highest gain, however the difference between the other groups' gain math scores was small.

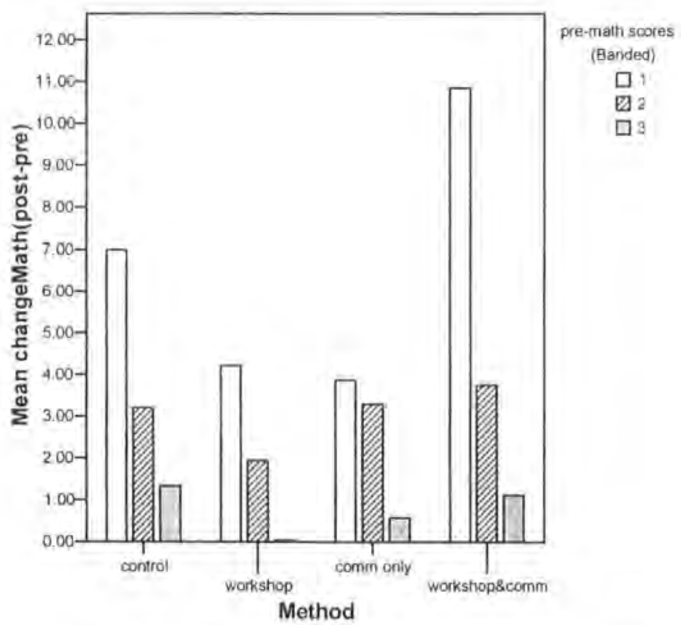


Figure 5-17 Bar charts of Gain math score by Bands (1,2,3)

[27] The problems associated with regression to the mean are arguably reduced here by undertaking comparisons, for the bottom band, between the control and experimental groups, but it should be noted that the communication group did have the lowest pre test math score. Furthermore the Band 1 group was not an especially extreme one, since it comprised a third of the pretest sample.

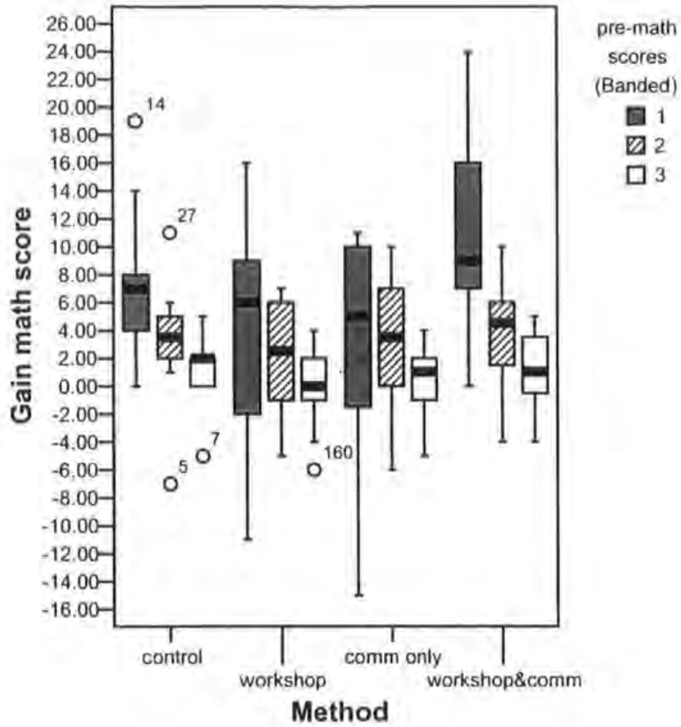


Figure 5-18 Boxplots of Gain math score by Bands (1,2,3)

The group means for gain math (post –pre math) presented as box plots in Fig 5-18, show that the Band 1 children in the workshop*communication group performed the best in terms of the gain math score which was higher than the children in the other experimental groups within the same band, as well as the other two bands (band 2 and 3).

Effect Sizes for Children's Gain Math

Effect size (ES) is a measure the magnitude of a treatment effect. Cohen (1988) defined *d*, a descriptive measure, as the difference between the means, $M_{1\ \text{Treatment}}$ - $M_{2\ \text{Control}}$, divided by a measure of variation (please see next page for formula) . Unlike significance tests, Cohen's d is independent of sample size.

By convention the subtraction, M_1 - M_2, (where M_1 stands for the group mean of the experimental group and M_2 stands for the group mean of the control group) is done so that the difference is positive if it is in the direction of *improvement* or in the predicted direction and negative if in the direction of *deterioration* or opposite to the predicted direction.

The value of Cohen's *d* , was calculated using the means and standard deviations of the change scores of the two groups (treatment and control) :

Cohen's $d = M_1 - M_2 / \sigma_{pooled}$, where $\sigma_{pooled} = \sqrt{[(\sigma_{1treatment}^2 + \sigma_{2Control}^2) / 2]}$[28]

Effect sizes (Cohen's d) for the different groups are summarized in the Table 5-14.

Table 5-14 Effect sizes of gain math scores for the treatment groups (All Children)

Method		Cohen's d (Gain Math)	Cohen's d (Gain Math %)
workshop	All	-0.52	-0.51
	Primary	-0.96	-0.87
	Tertiary	-0.38	-0.28
communication	All	-0.4	-0.28
	Primary	-0.91	-0.62
	Tertiary	-0.12	-0.02
workshop*communication	All	0.02	0.12
	Primary	-0.26	-0.16
	Tertiary	0.11	0.24

The effect sizes for the different groups for Band 1 children are represented in Figures 5-19 and 5-20.

[28] Strictly speaking, the compared samples should be of the same size.

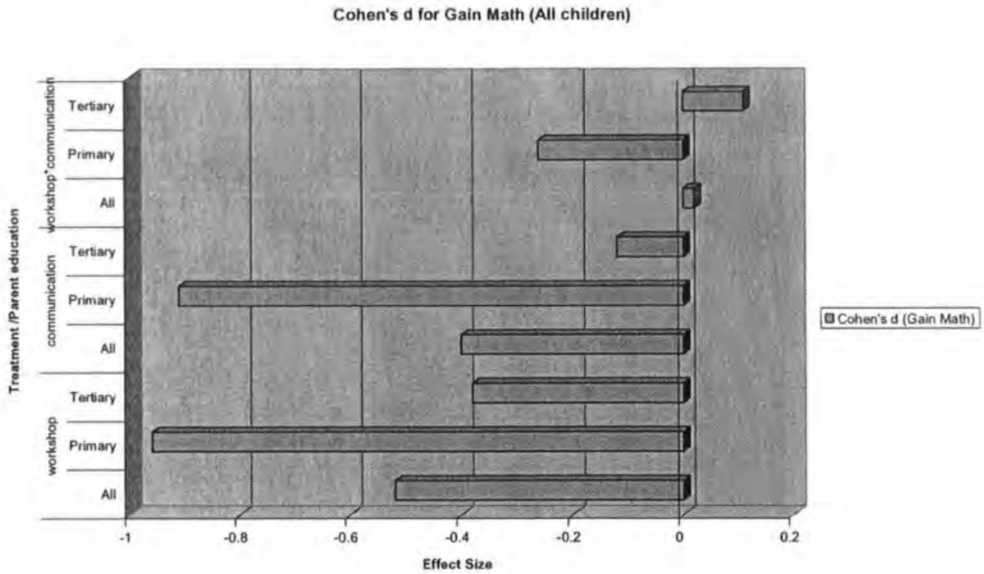
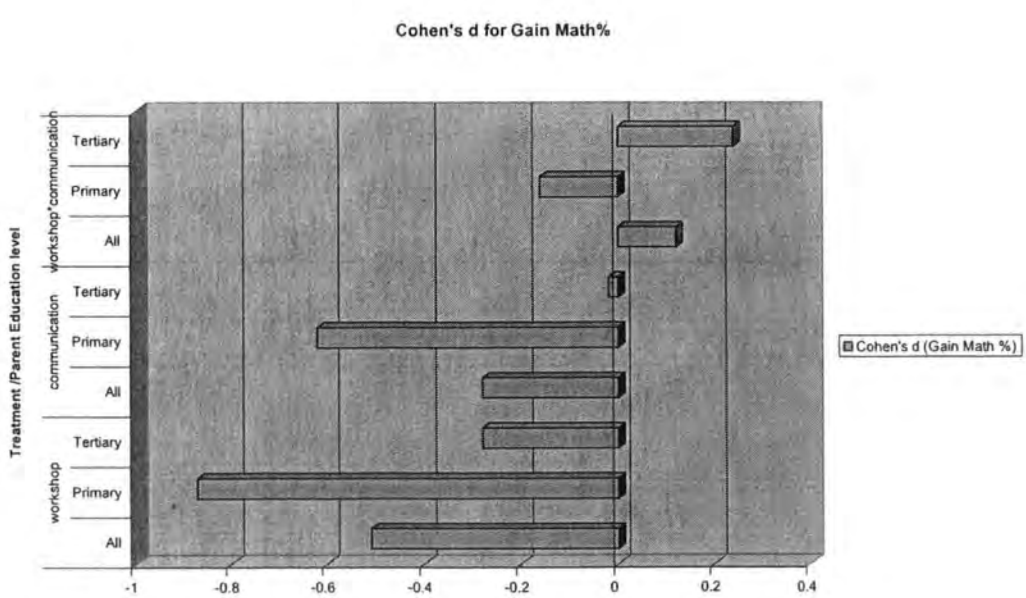


Figure 5-19 effect Size (Cohen's d) for gain math (All Children)

Figure 5-20 Effect Size (Cohen's d) for Gain Math % (All Children)



A small effect size was noted for children's gain math and gain math% scores in the workshop*communication group (0.11 and 0.24 respectively). The effect sizes of gain math scores were negative for the other treatment groups (Table 5-14). One reason for this could be attributed to the control group having the lowest pre-test scores for gain math and gain math (%) as compared to the workshop and workshop*communication groups. This together with the ceiling effect which the math assessment had on children's post math scores, might have resulted in the control group having relatively large gain math scores.

Band 1 Children

Effect Size for the Band 1 children's gain math and gain math % in the workshop*communication group were positive, in the moderate range (0.55). Large effect sizes were seen among children of Primary educated parents for Gain Math (1.52) and Gain Math % (1.13). Children of tertiary educated parents showed a small effect size for the same Gain Math scores (Table 5-15). For these parents, negative effect sizes were seen in both the workshop and communication groups for both Gain Math and Gain Math%. The effect sizes for the different groups for Band 1 children are represented in Figures 5-21 and 5-22.

Table 5-15 Effect sizes of gain math scores for the treatment groups (Band 1 Children)

Method		**Cohen's d (Gain Math)**	**Cohen's d (Gain Math %)**
workshop	All	-0.41	-0.41
	Primary	-0.49	-0.48
	Tertiary	-0.33	-0.18
communication	All	-0.57	-0.27
	Primary	-0.6	-0.32
	Tertiary	-0.41	-0.03
workshop*communication	All	0.54	0.52
	Primary	1.52	1.13
	Tertiary	0.23	0.52

Figure 5-21 Effect Size (Cohen's d) for Gain Math (Band 1 Children)

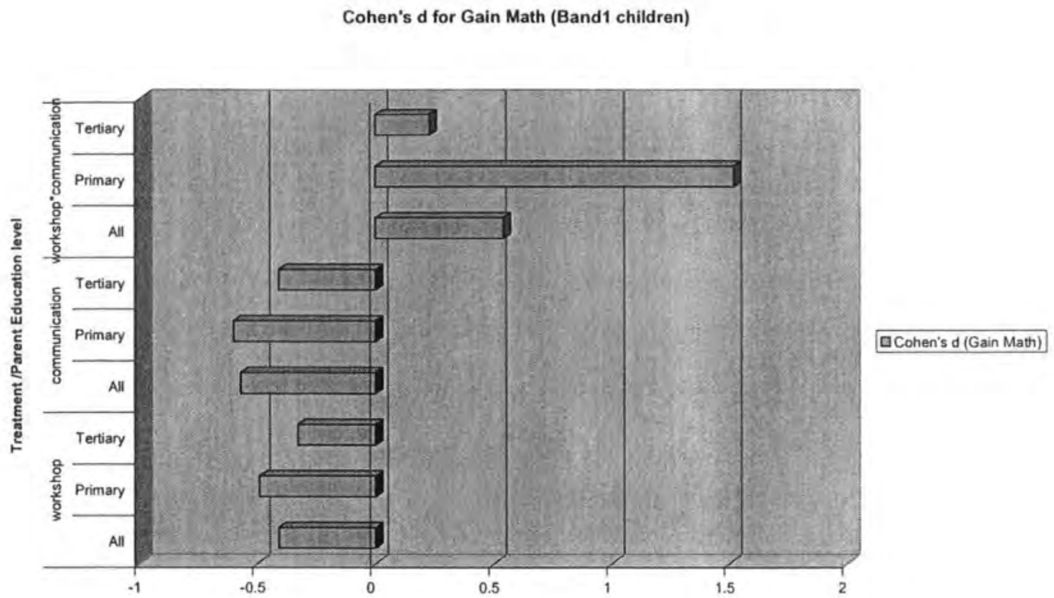
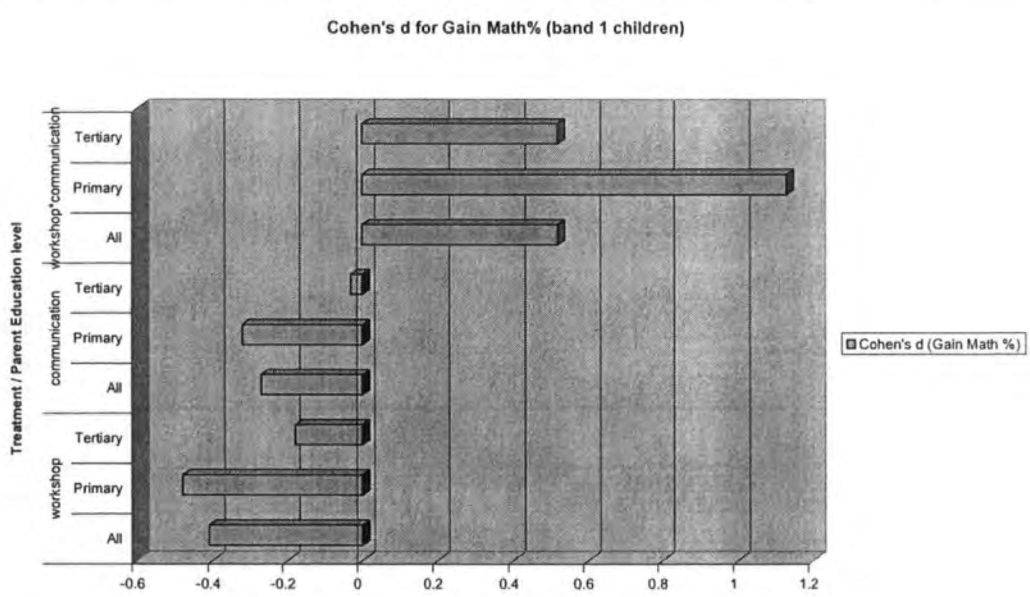


Figure 5-22 Effect Size (Cohen's d) for Gain Math % (Band 1 Children)



Hypotheses testing using ANOVA

Data Normality

Test of normality (Shapiro-Wilks W test)[29] was performed on the children's. pre-test, post-test math scores, Gain math and gain math % scores for all groups. This revealed that the data did not follow a normal distribution as the scores are statistically significant ($p<0.05$). The only two exceptions are the gain math scores for the control and workshop groups, where W is not significant, and therefore the gain math scores for these two groups fit the normal curve.

The implication of the deviation from normality for the children's math variables is in relation to the ANOVA statistic. However, the *F* test is remarkably robust to deviations from normality[30].

Table 5-16 Tests of Normality of the Pre-, Post- and Gain math scores

Measure	Method	Shapiro-Wilk		
		Statistic	df	Sig.
pre-math scores	Control	.949	40	.070
	Workshop	.936	66	.002
	Communication	.875	66	.000
	Workshop*Communication	.829	63	.000
post-math scores	Control	.871	40	.000
	Workshop	.844	66	.000
	Communication only	.802	66	.000
	Workshop*Communication	.784	63	.000
Gain math score	Control	.959	40	.152
	Workshop	.977	66	.272
	Communication	.962	66	.039
	Workshop*Communication	.919	63	.001
% ratio of post-pre/pre math	Control	.890	40	.001
	Workshop	.939	66	.003
	Communication	.846	66	.000
	Workshop*Communication	.603	63	.000

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[29] Shapiro-Wilks W. is recommended for small and medium samples up to n = 2000 (Garson, 2007)

[30] Cited from Stat Soft Inc. http://www.statsoft.com/textbook/stanman.html#deviation, retrieved on 1 May 2007

The skewness of the distribution usually does not have a sizable effect on the *F* statistic. If the *n* per cell is fairly large, then deviations from normality do not matter much at all because of the *central limit theorem*, according to which the sampling distribution of the mean approximates the normal distribution, regardless of the distribution of the variable in the population. For the same reason, the F test will not be seriously affected by light-tailedness or heavy-tailedness, unless the sample sizes are small (less than 5), or the departure from normality is extreme (kurtosis less than -1 or greater than 2)[31].

As seen in Table 5-16, the kurtosis of the Gain math scores are within the acceptable range i.e. not less than -1 and not greater than 2.

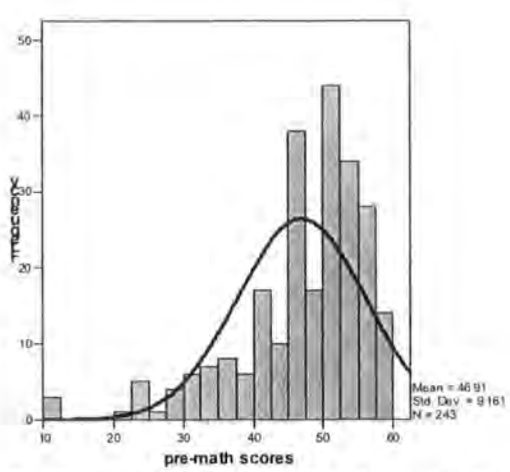


Figure 5-23 Histogram - Pretest Math score (mean) – all groups

[31] Cited from Stat Guide, http://www.basic.northwestern.edu/statguidefiles/oneway_b_anova_ass_viol.html#Non-normality, retrieved on 1 May 2007

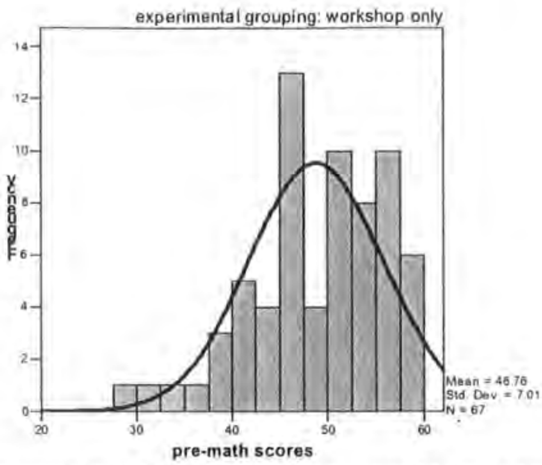


Figure 5-24 Histogram - Pretest Math score (mean) – Workshop group

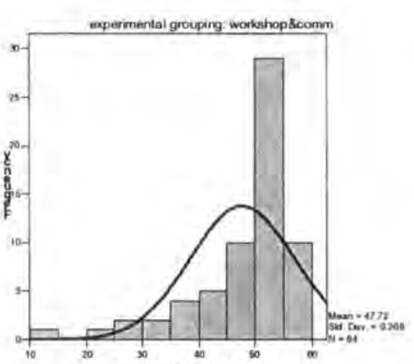


Figure 5-25 Histogram - Pretest Math score (mean) – Workshop*Communication group

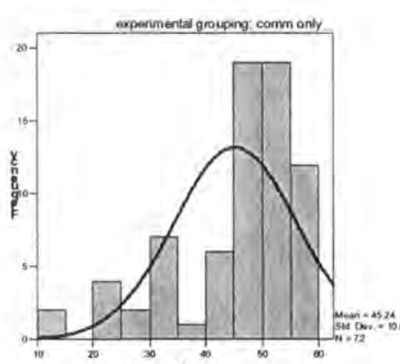


Figure 5-26 Histogram - Pretest Math score (mean) – Communication group

The pre-test math scores (Figure 5.23) for all children showed a normal distribution with a slight skewness towards a higher score (50 and above marks).

The pre test math scores for the three groups : workshop, communication and workshop*communication groups (Figure 5.24, 5-25 and Figure 5.26) were also skewed towards the higher end of marks, as compared to the control group. Such a distribution of marks would make it harder for gain math scores to show in the treatment groups, given that there was a possible ceiling effect in the math assessment.

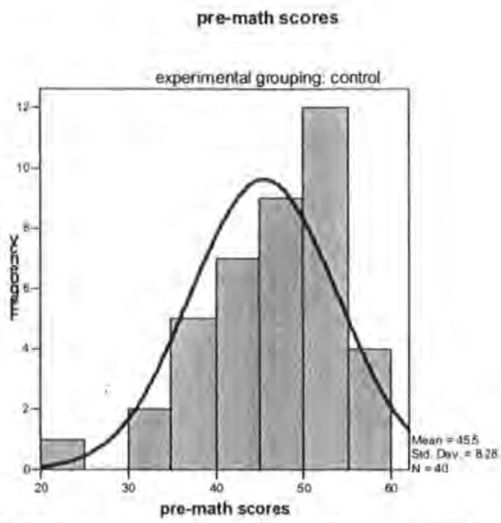


Figure 5-27 Histogram - Pretest Math score (mean) – control group

The control group showed a more even distribution of pre test math scores and a normal curve is more evident in this group (Fig 5-27). The number of children in this group was also smaller than the other three experimental groups due to a lower participation rate.

Gain Math - All children

For the purpose of comparison, further statistical analyses on the two variables (dependent): math gain (post – pre math) and percentage math gain will be presented in the following sections.

The group means will be compared to see if the differences between the groups with the different treatment conditions are statistically significant using ANOVA.

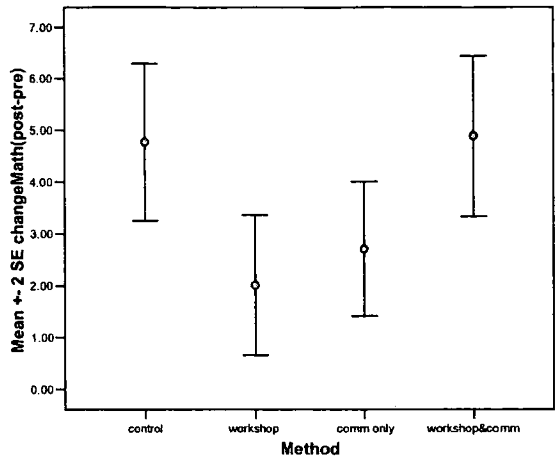


Figure 5-28 Error mean graph – all children

The error bar chart for gain math across the different experimental groups for all children is shown in Figure 5-28. The chart indicates, that on face value, there are between group differences between the workshop*communication and the workshop and communication group, as there is little overlap between these error bars, however, there is a clear overlap between the control group and the workshop*communication group, indicating that the difference between group means was not significant.

Table 5-17 Levene's test of equality of variances : Dependent Variable: gain math(post-pre)

F	df1	df2	Sig.
1.081	3	231	.358

Levene's test of equality of variances is not significant (p=.358) (Table 5-17). Hence, we can therefore assume homogeneity of variance, and apply ANCOVA to further analyse the group differences. The gain math score was analysed using Analysis of Variance with premath score as a covariate.

Table 5-18 Group mean of gain math score : Dependent Variable: gain math(post-pre)

Method	Mean	Std. Deviation	N
Control	4.77	4.81	40
Workshop	2.01	5.50	66
Communication only	2.71	5.27	66
Workshop*Communication	4.89	6.17	63
Total	3.45	5.63	235

The mean score for the Workshop*Communication (M=4.89, SD=6.17) (Table 5-18) group was higher than the mean scores for the Communication (M=2.71, SD= 5.27), Workshop (M=2.01, SD= 5.27) and Control groups (M=4.77, SD= 4.81).

Table 5-19 Tests of Between-Subjects Effects -Dependent Variable: gain math(post-pre) with premath score as a covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	1286.992	1	1286.992	51.491	.000	.183
Exptmethod	336.056	3	112.019	4.482	.004	.055
Error	5748.720	230	24.994			
Corrected Total	7408.187	234				

The one-way ANOVA in Table 5-19 showed F to be significant beyond the .01 level : $F(3,230)= 4.48$; $p<.005$. Partial eta squared = 0.055 (medium effect), indicating that Experimental Method did have an effect on the children's gain in math score.

The next step would be to examine the differences between the different experimental group means. The Tukey Post Hoc test results for the experimental method are shown in Table 5-20. It can be seen that the gain math scores differ significantly between workshop*communication and workshop groups (B=2.52, p=.005); partial eta squared = .034 representing a small effect and between workshop*communication and communication (B=2.74, p=.002); partial eta squared = 0.04 representing a small effect groups.

The difference between the control and communication groups were significant at the .042 level.

Table 5-20 Pairwise Comparisons of gain math by experimental group with pre test mathscore as a covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	1.832	1.010	.071
	Communication only	2.051(*)	1.002	.042
	Workshop*Communication	-.688	1.014	.498
Workshop	Control	-1.832	1.010	.071
	Communication only	.219	.880	.804
	Workshop*Communication	-2.520(*)	.882	.005
Communication	Control	-2.051(*)	1.002	.042
	Workshop	-.219	.880	.804
	Workshop*Communication	-2.739(*)	.884	.002
Workshop*Communication	Control	.688	1.014	.498
	Workshop	2.520(*)	.882	.005
	Communication only	2.739(*)	.884	.002

Based on estimated marginal means* The mean difference is significant at the .05 level.

Interaction effect

To examine the presence of an interaction effect on the math scores, an ANOVA was run for the different experiment groups in terms of the presence and absence of the two factors : communication and workshop. The group means are summarized in Table 5-21:

Table 5-21 Group Means of Gain math (Post – Pre) score Dependent Variable: gain math(post-pre) (without covariate)

Workshop only	Communication only	Mean	Std. Deviation	N
No Workshop	No Communication	4.78	4.81	40
	Communication	2.71	5.27	66
	Total	3.49	5.18	106
Workshop	No Communication	2.02	5.50	66
	Communication	4.89	6.17	63
	Total	3.42	5.99	129
Total	No Communication	3.06	5.40	106
	Communication	3.78	5.81	129
	Total	3.45	5.63	235

Table 5-22 Levene's Test of Equality of Error Variances(a) : Dependent Variable: gain math(post-pre)

Dependent Variable: Gain math score

F	df1	df2	Sig.
1.081	3	231	.358

Levene's test (Table 5-22) of equality of variances is not significant (p=.358). Hence, we can assume homogeneity of variance, and apply ANCOVA to further analyse the group differences.

Table 5-23 Tests of Between subjects effects -Dependent Variable: gain math(post-pre) with covariate

Dependent Variable: Gain math score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	1286.992	1	1286.992	51.491	.000	.183
workshop	11.281	1	11.281	.451	.502	.002
comm	3.093	1	3.093	.124	.725	.001
workshop * comm	293.147	1	293.147	11.728	.001	.049
Error	5748.720	230	24.994			
Total	10207.000	235				
Corrected Total	7408.187	234				

a R Squared = .224 (Adjusted R Squared = .211)

The ANOVA shown in Table 5-23 for the workshop, communication and workshop*communication experimental conditions shows that the interaction effect between workshop and communication is significant. F was significant beyond the .05 level : $F(1,230)= 11.728$; $p<.01$, partial Eta = 0.049, showing a small to medium effect [32].

The main effects of workshop and communication were not significant.

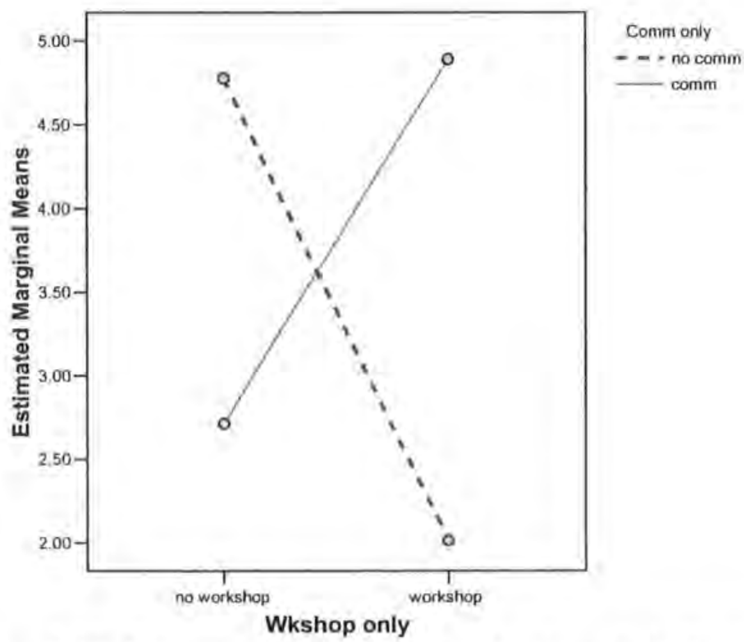


Figure 5-29 Estimated marginal means of gain math (without covariate)

The profile plots for the workshop and communication conditions shown in Figure 5-29 indicate that :

1. There is an interaction effect between workshop and communication conditions as seen from the intersecting lines, indicating that the effect of workshop is affected by the communication condition.
2. Better improvement in children's math scores was seen in the group with both workshop and communication conditions than

[32] Refer to Appendix N, p. 342

the group with workshop only and communication only condition.

Hence, the effect of workshop on gain math score needs to be interpreted in the light of the presence of the communication condition, which in this case, a higher gain math score was evident in the group which had both the workshop and communication conditions.

This could have been a chance finding but it might also be explained that the workshops, when combined with newsletters which provided useful information for parents to support their child's learning at home had a stronger effect.

Gain math for Band 1 children

The next section will examine the gain math scores of children in the Band 1 (low) group.

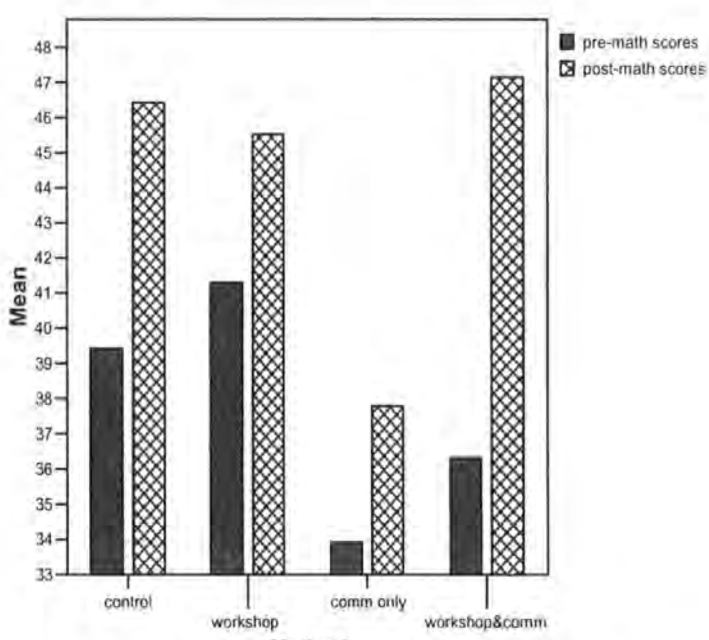
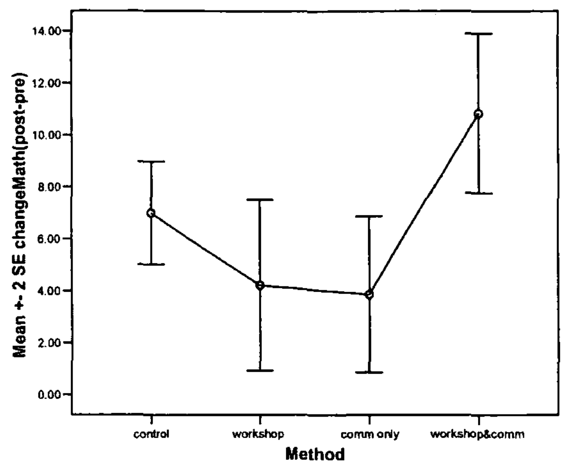


Figure 5-30 Bar graph of pre and post math score (Band 1) children

The post test math score was highest in the workshop*communication group (Figure 5-30), which also had the largest gain math score as well.

Figure 5-31 Error mean graph of gain math score (Band 1)



The error bar chart for the Band 1 group of children presented in Fig 5-31 shows a distinctly higher group mean for children in the workshop*communication group compared to the other three groups.

Table 5-24 Group Means of Gain math score (Band 1) children :Dependent Variable: gain math(post-pre) with pre math as covariate

Method	Mean	Std. Deviation	N
Control	7.00	4.54	21
Workshop	4.22	7.89	23
Communication	3.87	7.20	23
Workshop*Communication	10.84	6.71	19
Total	6.27	7.17	86

The mean score for the workshop*communication (Table 5-24) (M=10.64, SD=6.71) condition was higher than the mean scores for the communication (M=3.32, SD= 7.20), workshop (M=4.71, SD= 7.88) and control groups (M=7.23, SD= 4.53).

Table 5-25 Levene's Test of Equality of Error Variances(a) : Dependent Variable: gain math(post-pre)

F	df1	df2	Sig.
3.292	3	82	.025

Levene's Test confirms that the error variance of the dependent variable is equal across groups (Table 5-25).

Table 5-26 Tests of Between subjects effects : Dependent Variable: gain math(post-pre) with premath as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	94.13	1	94.13	2.10	.152	.025
Exptmethod	636.42	3	212.14	4.72	.004	.149
Error	3636.92	81	44.90			
Total	7747.00	86				
Corrected Total	4368.85	85				

a R Squared = .168 (Adjusted R Squared = .126)

The one-way ANOVA (Table 5-26) showed F to be significant beyond the .01 level : $F(3,81) = 4.72$; $p < .005$. Partial eta squared = .149 (large effect)[33], indicating that Experimental Method did have an effect on the children's gain math.

Table 5-27 Dependent Variable: gain math(post-pre) with premath as covariate

Parameter	B	Std. Error	t	Sig.	Partial Eta Squared
Control	-3.402	2.143	-1.587	.116	.030
Workshop	-5.919	2.134	-2.774	.007	.087
Communication only	-7.312	2.091	-3.498	.001	.131
Workshop*Communication	0(a)	.	.	.	.

a This parameter is set to zero because it is redundant.

The Tukey Post Hoc test results for the experimental method are shown in the Table 5-27 . It can be seen that the gain math scores differ significantly between workshop*communication and workshop groups (B=5.92., p=.007); Partial eta squared = .087 representing a medium effect

[33] Refer to Appendix N, p. 342

The difference between workshop*communication and communication group (Table 5-28) was also significant (B=7.31, p=.001); partial eta squared = .131 representing a large effect but no significant difference was observed between the treatment and control group.

Table 5-28 Pairwise Comparisons :Dependent Variable: gain math(post-pre) with pre test math as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	2.517	2.031	.219
	Communication	3.910	2.093	.065
	Workshop*Communication	-3.402	2.143	.116
Workshop	Control	-2.517	2.031	.219
	Communication	1.393	2.104	.510
Communication	Control	-3.910	2.093	.065
	Workshop	-1.393	2.104	.510
Workshop* Communication	Control	3.402	2.143	.116
	Workshop	5.919(*)	2.134	.007
	Communication	7.312(*)	2.091	.001

Based on estimated marginal means * The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Interaction effect

To examine the presence of interaction effect on the math scores, an ANOVA was run for the different experiment groups in terms of the presence and absence of the two factors: Communication and workshop. The group means are summarized in Table 5-29 :

Table 5-29 Dependent Variable: Gain math (post-pre) without covariate

Wkshop only	Communication only	Mean	Std. Deviation	N
no Workshop	no Communication	7.00	4.54	21
	Communication	3.87	7.20	23
	Total	5.36	6.21	44
Workshop	no Communication	4.22	7.88	23
	Communication	10.84	6.71	19
	Total	7.21	8.02	42
Total	no Communication	5.54	6.58	44
	Communication	7.02	7.74	42
	Total	6.27	7.17	86

Table 5-30 Tests of Between-Subjects Effects Dependent Variable: gain math(post-pre) with pre test math as covariate – Band 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	94.13	1	94.13	2.096	.152	.025
Workshop	120.31	1	120.31	2.679	.106	.032
Communication	19.17	1	19.17	.427	.515	.005
Workshop * Communication	515.96	1	515.96	11.491	.001	.124
Error	3636.92	81	44.90			
Total	7747.00	86				
Corrected Total	4368.85	85				

a R Squared = .168 (Adjusted R Squared = .126)

The one-way ANOVA in Table 5-30 showed F to be significant beyond the .01 level : $F(1,81)=11.491$; $p<.001$. Partial eta squared = 0.124 (large effect), indicating that the interaction effect (workshop*communication) did have an effect on the children's gain math.

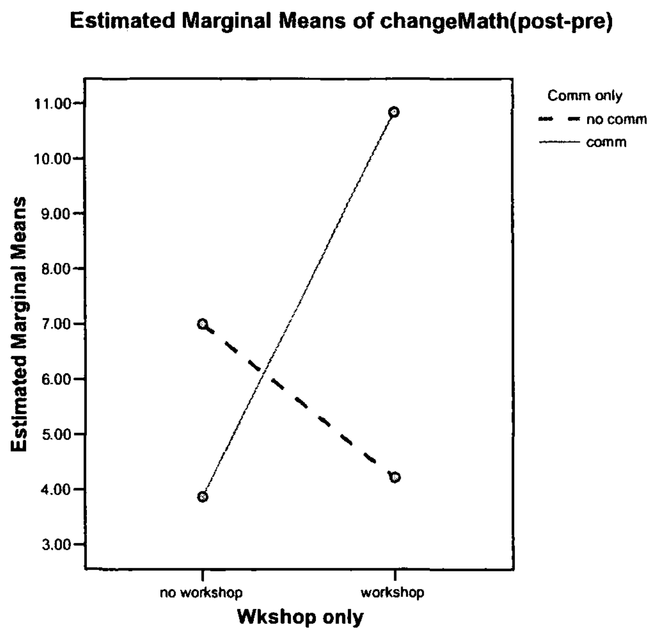


Figure 5-32 Means plot of gain math scores

The same interaction effect between workshop and communication treatment was seen in the Band 1 group of children (Fig 5-32):

- Better improvement in children's math scores was seen in the group with both workshop and communication conditions than the group with workshop only and communication only condition.
- The means plots for gain math for the two conditions, workshop and communication showed the presence of an interaction effect. Hence, the effect of workshop on gain math score needs to be interpreted in the light of the presence of the communication condition, which in this case, a higher gain math score is seen in the group which had both the workshop and communication conditions and the gain math score was lower when the communication condition was absent.

However, due to the small number of children (n=19) in the Band 1 group, and the Test of Equality of Error Variances was significant ($p<0.05$), the results need to be interpreted with some caution.

Analysis of Children's Gain Math by Parent Education Level

The next section will examine the gain math scores of children by parent educational level (Primary/secondary and Diploma/Tertiary).

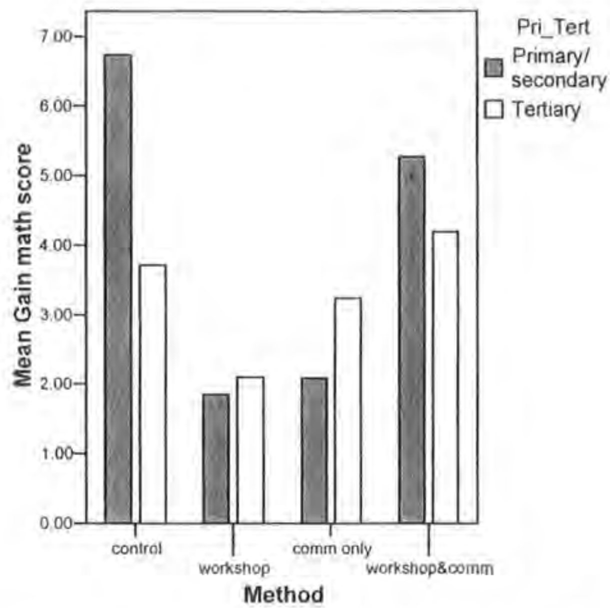


Figure 5-33 Bar chart of children's gain math score by parent education level

- Primary/Secondary education level

The gain math score was highest in the control group and workshop*communication groups among children of parents with primary/secondary education. For the three treatment groups, the highest gain math score was seen in the workshop*communication group (M = 5.27, SD=6.68) (Table 5-31).

Children in the workshop and communication groups whose parents were tertiary educated, fared slightly better in their gain math scores as compared to those whose parents were primary /secondary educated (Figure 5-33).

Table 5-31 Children gain math score – parents with primary /secondary education with pre test math as covariate

Dependent Variable: Gain math score

Method	Mean	Std. Deviation	N
Control	6.74	4.20	19
Workshop	1.84	5.90	32
Communication only	2.08	6.01	36
Workshop*Communication	5.27	6.68	22
Total	3.47	6.11	109

a Pri_Tert = Primary/secondary

Table 5-32 Levene's Test of Equality -Gain math score

F	df1	df2	Sig.
1.337	3	105	.266

Levene's test of equality of variance is not significant (p=.266) (Table 5-32) Hence, we can assume homogeneity of variance and apply ANCOVA to further analyse the group differences.

Table 5-33 Tests of Between-Subjects Effects: Gain math score with premath as covariate (Parents with primary /secondary education)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	385.054	1	385.054	12.460	.001	.107
Exptmethod	368.565	3	122.855	3.975	.010	.103
Error	3213.963	104	30.903			
Total	5338.000	109				
Corrected Total	4027.138	108				

a R Squared = .202 (Adjusted R Squared = .171) b Pri_Tert = Primary/secondary

The One-way ANOVA in Table 5-33 showed F to be significant at the .01 level : F (3,104) = 3.975; p<.01, partial eta squared = .103 showing a high effect, indicating that experimental method did have an effect on the children's gain math score.

Table 5-34 Tests of Between-Subjects Effects - Gain math score with premath as covariate

Dependent Variable: Gain math score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	385.054	1	385.054	12.460	.001	.107
workshop	2.737	1	2.737	.089	.767	.001
comm	2.466	1	2.466	.080	.778	.001
workshop * comm	353.858	1	353.858	11.450	.001	.099
Error	3213.963	104	30.903			
Total	5338.000	109				
Corrected Total	4027.138	108				

a R Squared = .202 (Adjusted R Squared = .171)

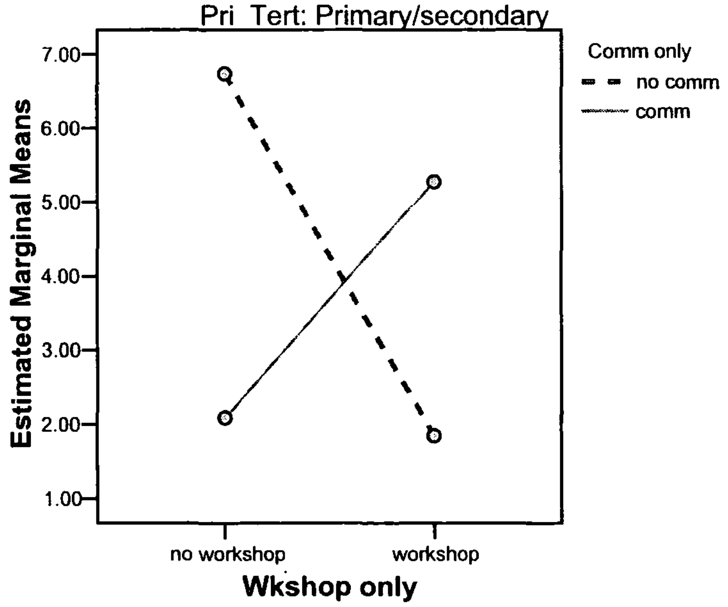


Figure 5-34 Means plots of gain math score

From the means profile plots (Fig 5-34), an interaction effect is evident between the two conditions communication and workshop. Children in the workshop*communication group had higher gain in math scores as compared to those who were in the workshop only group. The combined treatment effect was found to be significant beyond the .001

level : F (1,104) = 11.45; p<.001, partial eta squared = .099 showing a large effect, indicating that the combined treatment condition did have an effect on the children's gain math score (Table 5-34).

- Diploma/Tertiary education level

Among parents who were tertiary educated, the largest gain math scores was found in the workshop*communication group (M = 4.19) (Table 5-35).

Table 5-35 Children Gain math score (Parents with Diploma /tertiary education) with premath as covariate

Method	Mean	Std. Deviation	N
Control	3.7143	3.26823	14
Workshop	2.0968	4.94203	31
Communication only	3.2400	4.24539	25
Workshop*Communication	4.1944	5.49191	36
Total	3.2925	4.81657	106

Table 5-36 Levene's Test of Equality Gain math score

F	df1	df2	Sig.
1.043	3	102	.377

Levene's test of equality of variance is not significant (p=.377) (Table 5-36) Hence, we can assume homogeneity of variance and apply ANCOVA to further analyse the group differences.

Table 5-37 Tests of Between-Subjects Effects : Gain math score with premath as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	709.703	1	709.703	43.441	.000	.301
Exptmethod	55.641	3	18.547	1.135	.339	.033
Error	1650.062	101	16.337			
Total	3585.000	106				
Corrected Total	2435.934	105				

a R Squared = .323 (Adjusted R Squared = .296) b Pri_Tert = Tertiary

The One-way ANOVA showed that the experimental method as well as the two treatment conditions did not have a significant effect on the gain math score among parents who were tertiary educated (Table 5-37).

Table 5-38 Tests of Between-Subjects Effects : Gain math score (with premath as covariate)

Dependent Variable: Gain math score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	709.703	1	709.703	43.441	.000	.301
workshop	14.501	1	14.501	.888	.348	.009
comm	1.014	1	1.014	.062	.804	.001
workshop * comm	38.209	1	38.209	2.339	.129	.023
Error	1650.062	101	16.337			
Total	3585.000	106				
Corrected Total	2435.934	105				

a R Squared = .323 (Adjusted R Squared = .296)

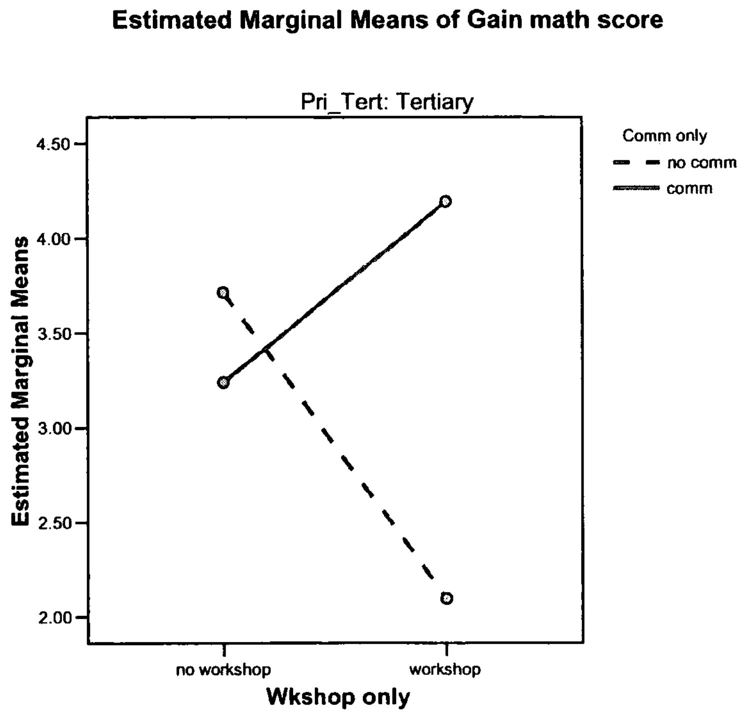


Figure 5-35 Means Plots for gain math for Tertiary educated parents (without covariate)

Means plots (Figure 5-35) showed that there was an interaction effect between the two treatment conditions. However, this effect was not significant (Table 5-38). Gain math scores were also higher among children in the workshop*communication group, compared to those who were in the workshop group.

Gain Math (Percentage)

All Children

In this section, the same range of analyses as in the previous section for the Gain math (%) measure, will be employed and presented.

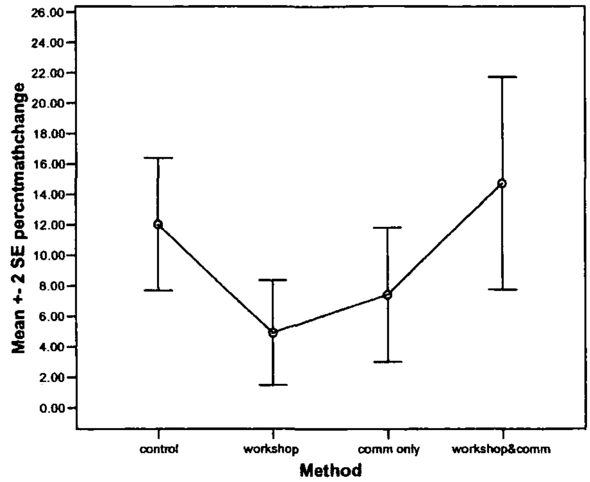


Figure 5-36 Error mean graph of percent in gain math

Table 5-39 Group mean of gain math (%)

Method	Mean	Std. Deviation	n
Control	12.04	13.73	40
Workshop	4.92	13.99	66
Communication only	7.42	17.93	66
Workshop*Communication	14.72	27.73	63
Total	9.46	19.86	235

As seen in Table 5-39, the mean score for the workshop*communication (M=14.72, SD=27.73) condition was higher than the mean scores for the communication (M=7.42, SD=17.93), workshop (M=4.92, SD= 13.99) and control groups (M=12.04, SD= 13.73).

Table 5-40 Levene's Test of Equality of Error Variances(a) : Dependent Variable: gain math (%)

F	df1	df2	Sig.
1.555	3	231	.201

Levene's Test of the null hypothesis confirm that the error variance of the dependent variable is equal across groups (Table 5-40).

Table 5-41 Tests of Between-Subjects Effects : Dependent Variable: gain math (%) with premath score as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
pre_mathscore	29514.060	1	29514.060	114.805	.000	.333
Exptmethod	3624.013	3	1208.004	4.699	.003	.058
Error	59128.335	230	257.080			
Corrected Total	92288.376	234				

a R Squared = .359 (Adjusted R Squared = .348)

The one-way ANOVA (Table 5-41) showed F to be significant beyond the .01 level : $F(3, 234)= 4.69$; $p<.005$. Partial eta squared = .058 (medium effect), indicating that experimental method did have an effect on the children's percentage change math.

Table 5-42 Parameter Estimates : Dependent Variable: gain math (%)

Parameter	B	Std. Error	t	Sig.	Partial Eta Squared
pre_mathscore	-1.27	.12	-10.71	.000	.333
Control	-5.43	3.25	-1.67	.096	.012
Workshop	-8.11	2.83	-2.87	.005	.035
Communication	-10.00	2.84	-3.53	.001	.051
Workshop*Communication	0(a)	.	.	.	.

a This parameter is set to zero because it is redundant.

The Tukey Post Hoc test results for the experimental method are shown in the Table 5-42. It can be seen that the percentage gain math scores differ significantly between workshop*communication and workshop only (B=8.11., p=.005); Partial eta squared = .035 representing a small effect.

The same is observed between workshop*communication and communication groups (B=9.99, p=.001); Partial eta squared = .051

representing a small effect but no significant difference was observed when compared with the control group (Tables 5-42 and 5-43).

Table 5-43 Pairwise Comparisons Dependent Variable: gain math (%) with premath as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	2.674	3.239	.410
	Communication	4.564	3.213	.157
	Workshop*Communication	-5.435	3.252	.096
Workshop	Control	-2.674	3.239	.410
	Communication	1.889	2.821	.504
Communication only	Control	-4.564	3.213	.157
	Workshop	-1.889	2.821	.504
Workshop*Communication	Control	5.435	3.252	.096
	Workshop	8.109(*)	2.829	.005
	Communication	9.999(*)	2.835	.001

Band 1 group of children

Among the Band 1 group of children, workshop*communication group showed the largest increase in percentage. (Fig 5-37 and 5-38).

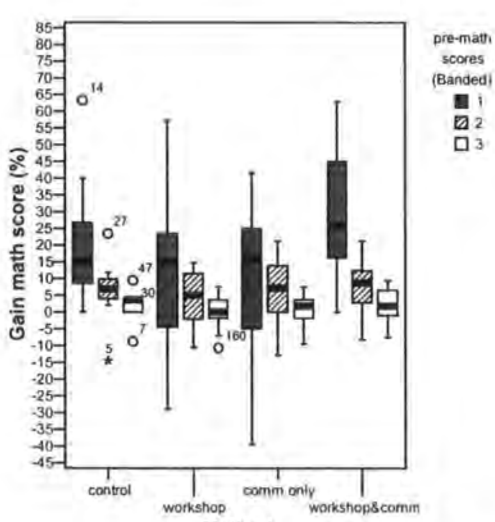


Figure 5-37 Box plots of gain math (%) by Bands (1,2,3)

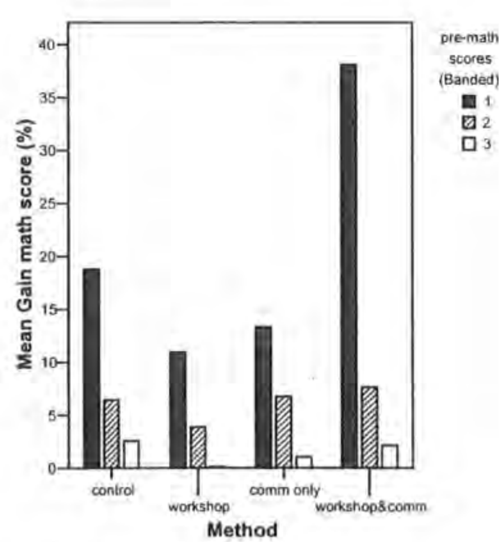


Figure 5-38 Bar charts of Gain math (%) by Bands (1,2,3)

Table 5-44 Group means of percentage gain math (Band 1)

Method	Mean	Std. Deviation	N
Control	18.76	14.56	21
Workshop	10.95	21.09	23
Communication only	13.34	27.86	23
Workshop*Communication	38.11	41.12	19
Total	19.50	28.84	86

The children's mean score for gain math (%) in the workshop*communication (M= 38.11, SD=41.12) group was higher than the children in the Communication (M=13.34, SD=27.86), workshop (M=10.95, SD= 21.09) and control (M=18.76, SD= 14.56) groups (Table 5-44).

The error bar graphs in Fig 5-39 also shows a greater overlap among the control, workshop and communication groups, indicating that the group differences between these groups were not significant.

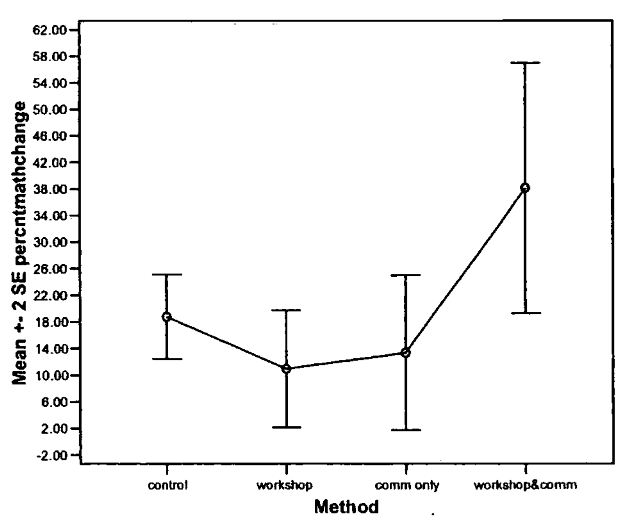


Figure 5-39 Error mean graph of percentage gain math (Band 1)

Table 5-45 Levene's Test of Equality of Error Variances(a) :

Dependent Variable: gain math (%)

F	df1	df2	Sig.
3.195	3	82	.028

Table 5-46 Tests of Between-Subjects Effects : Dependent Variable: gain math (%) with premath as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Exptmethod	9018.504	3	3006.168	5.377	.002	.166
Error	45283.745	81	559.059			
Corrected Total	70691.468	85				

a R Squared = .359 (Adjusted R Squared = .328)

The one-way ANOVA (Table 5-46) showed F to be significant beyond the .01 level : $F(3, 85)= 5.38$; $p<.005$. Partial eta squared = .16 (large effect), indicating that experimental method did have an effect on the children's percentage change math.

The Tukey Post Hoc test results for the experimental method are shown in the Table 5-47. It can be seen that the Percentage Gain math scores differ significantly between workshop*communication and workshop only (B=17.89., p=.02); Partial eta squared = .065 representing a medium effect

The percentage Gain math scores also differ significantly between the workshop*communication and communication groups (B=29.24, p=.001); Partial eta squared = .162 representing a large effect but no significant difference is observed between the workshop*communication and the control groups (Table 5-47).

Table 5-47 Pairwise Comparisons: Dependent Variable: gain math (%)

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Workshop*Communication	Control	13.565	7.563	.077
	Workshop	17.891(*)	7.529	.020
	Communication only	29.236(*)	7.377	.000

Based on estimated marginal means * The mean difference is significant at the .05 level. a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Summary of Findings and Interpretations on Children's Math Score

A summary of the findings in relation to children's math gain scores is found in Table 5-48. Positive math gain and percentage math gain were observed across all groups, with the highest found in the workshop*communication group, followed by the control, communication and workshop groups. However, the effect sizes were negligible for all treatment groups.

All Children

The first two hypothesis tests for the main effects of the two factors. The null hypothesis for the two main effects is that there are no differences among the levels of the factors (i.e. $H_0 : \mu_{\text{No Communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{Workshop}}$)

- ANOVA analysis showed that experimental method did have an effect on the children's Gain math score. The one-way ANOVA showed F to be significant beyond the .01 level : $F(3,230)= 4.48$; $p<.005$. Partial eta squared = 0.055 (medium effect).

- However, the main effects of communication and workshop conditions did not have a significant effect on children's gain in math. Hence, the null hypotheses $H_0 : \mu_{\text{No Communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{Workshop}}$ could not be rejected.

This could have been due to the following reasons :
The information given to parents either by Newsletters or Workshops alone were less effective in terms of helping parents to understand the content and ideas on how to support their children learn math at home. Parents in the communication group probably could not effectively recall or fully understand what was taught in the centres due to a lack of the hands on demonstration given during the workshops. Those who attended the workshops but who did not have any newsletters were slightly less equipped in terms of ideas for math activities that they could carry out at home with their children.

Table 5-48 Summary of Findings for Children's Math gain scores

Dependent variable (post-pre)	Levels	Positive – starting with Highest gain score	Significance		Effect Size
Children's Math Gain	All children	1. Workshop*Communication 2. Control 3. Communication 4. Workshop	Experiment method is significant, Not significant for main effect : Workshop, Communication	Interaction effect significant	Negative effect size for all three treatment groups except for the Workshop*Communication group (0.02)
	Primary/ Secondary	1. Control 2. Workshop*Communication 3. Communication 4. Workshop	Experiment method is significant,	Interaction effect significant	Negative effect size for all three treatment groups
	Diploma/ Tertiary	1. Workshop*Communication 2. Control 3. Communication 4. Workshop	Experiment method not significant	Not significant	Small positive effect size (0.11)
	Band 1	1. Workshop*Communication 2. Control 3. Workshop 4. Communication	Experiment method and Workshop* Communication Condition is significant	Interaction effect significant	Positive effect sizes seen in Workshop*Communication group : • Large positive effect size (1.52) for children of Primary educated parents • Moderate positive effect size (0.54) (All children). • Small effect size (0.23) for children of Tertiary educated parents
Children's Math Gain (percentage)	All	1. Workshop*Communication 2. Control 3. Communication 4. Workshop	Experiment method is significant, Not significant for main effect : Workshop, Communication	–	• Negative effect size for Workshop and Communication groups • Small positive effect size (0.12) for Workshop*Communication group • Small positive effect size (0.24) for children of Tertiary educated parents
	Band 1	1. Workshop*Communication 2. Control 3. Workshop 4. Communication	Experiment method is significant	–	Positive effect sizes seen in Workshop*Communication group : • Large positive effect size (1.13) for children of Primary educated parents • Moderate positive effect size (0.52) -All children • Moderate effect size (0.52) for children of Tertiary educated parents

The fact that not all parents in the workshop group used the math kits in the same way, effectively, was another possible reason why the workshop condition did not result in a significant effect. There could have been qualitative differences among parents in the ways that they made use of these kits to help their children learn math at home. Some parents could have been more creative and effective in making use of these math kits as well as the ideas shared during the workshops with their children at home. Also, it was noted that not every parent attended all three workshops, and may therefore not have gained as much in terms of the depth of knowledge and understanding about how to support their child's math learning at home. However, despite the lack of a significant finding here, parents' feedback on the workshops seem to indicate that the workshops did have an impact on their own self learning and had helped to increase their understanding of how to help their child learn math at home.[34]

As for parents in the communication group, it was not possible to ascertain if all parents had read and applied the information in the newsletters in the same ways. Some parents could have been better motivated, or have had more time than others to take the ideas and resources to plan and conduct activities at home with their children, which could have helped the children better understand the math concepts. Other parents may not have been able to make use of the information in a meaningful way.

Furthermore, feedback from parents in the communication group showed fewer positive statements about their own learning towards helping their children learn math at home as compared to parents who attended the workshops[35].

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[34] Please see, for supporting evidence, chapter 4, pp. 117

[35] Please see, for the supporting analysis, chapter 4, pp. 125

Interaction Effect

The third hypothesis was to test for the combination of the two factors together. The null hypothesis for the interaction is that the combination of the two factors will have no effect on the children's math outcome (i.e. $H_0 : \mu_{\text{No Workshop*Communication}} = \mu_{\text{Workshop*Communication}}$).

Pairwise comparisons of group differences between (a) workshop*communication and workshop and (b) workshop*communication and communication groups were significant. However, the treatment groups did not differ significantly from the control group.

The interaction effect workshop*communication was significant beyond the .05 level : $F(1,231)= 11.24$; $p<.05$, partial Eta = .046, showing a medium positive effect. The hull hypothesis $H_0 : \mu_{\text{No Workshop*Communication}} = \mu_{\text{Workshop*Communication}}$ is therefore rejected. In particular, the interaction effect was also significant for children whose parents were primary/secondary educated. This could have been due to:

a. The combined effect, which gave parents the information on what the children were learning at the centres, as well as the hands-on sessions conducted during the parent math workshops, seemed to have been more effective in helping parents better understand and acquire ideas and teaching approaches to support their children in math learning at home. The information disseminated in the newsletters and during the workshops could have been better reinforced as compared to just having the newsletter and workshop conditions by itself, as parents could have been better able to understand and use the math kits more effectively, when they could observe and learn from the teachers, as well as be able to apply the information given in the newsletters more effectively[36].

b. For parents who may not have attended all three workshops, they were also kept informed, through the newsletters, of what they could do to support their children's learning at home as they were given additional information and ideas

c. However, it is also noted that the teachers themselves could have influenced the children's learning as seen in the following anecdotal records :

Teacher P, from the workshop*communication group shared about her own teaching practice :

> Using some ideas from the math kits, I have created several different activities for the children to play with in the Math corner e.g. Number bond games using different food items, sorting of food pictures and comparing more and less using the manipulative counters such as lego bricks and 'kutti kutti'[37].

Teacher M from the workshop group, who reflected in her journal :

> The training and experience provided by Ms Chan has widened my interest for teaching math in a fun way and motivated me to search for new ideas and creative ways (of teaching). I began to search for ideas by reading different approaches in integrating literacy and math.
>
> Personally, the math workshop and training has given me an insight into the different approaches to teach math in a fun way. I am using more resources and the internet to source for more ideas. I have developed more ideas as I planned more games for the children and they have taught me a lot as I listened to their comments and new ways of playing certain games.

Hence, in addition to what the parents could have done at home to support their child's math learning, the children's math learning could have also been shaped by their teacher's scaffolding and teaching which were in turn influenced by the math kits.

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[36] Please see, for supporting evidence, chapter 4, pp. 124

[37] Kutti Kutti refers to a type of children's play material comprising colourful animal shapes that can be used for sorting and counting.

Band 1 children

Gain math and percentage gain math scores were highest among the Band 1 children in the workshop*communication group. (M=10.84, SD=6.71, n=19), with a moderate effect size of 0.55 and 0.54 (positive).

The one-way ANOVA for math gain showed F to be significant beyond the .01 level : F(3,81)= 4.72; p<.005. Partial eta squared = .149 (large effect), indicating that Experimental Method did have an effect on the children's gain math. The interaction effect workshop*communication was significant beyond the .001 level : F(1,82)= 11.17; p<.001, partial Eta =0.124, showing a large positive effect.

Pairwise comparisons of group (gain math) differences between (a) workshop*communication and workshop and (b) workshop*communication and communication groups were significant, but the treatment groups did not differ significantly from the control group. The gain math scores differed significantly between workshop*communication and workshop groups (p<.05); Partial eta squared = .087 representing a medium effect

The difference between workshop*communication and communication groups was significant (p<.05); Partial eta squared = .131 representing a large effect but no significant difference was observed between the treatment and the control group.

However, due to the small N size (n=86) in the Band 1 group, as well as regression to the mean effect, the above result needs to be interpreted with some caution.

Children with primary/secondary educated parents

Children's gain math scores were highest in the workshop*communication group for those whose parents who were primary/secondary educated, as compared to those with tertiary educated parents. The effect of the combined condition was found to be significant ($F(3,104) = 3.975$; $p<.01$; partial eta squared = .103 showing a high effect). The effect sizes for both Gain math (1.52) and Gain math (%) (1.13) were also large.

One implication for this finding is that children of parents with primary /secondary education could benefit more from the combined treatment conditions of workshop and communication, as compared to tertiary educated parents.

The results reported in this section recognizes the following factors that may have affected the overall results of the math scores :

1. Since the math assessment had a ceiling effect, and the pre test math scores for the workshop group (M=48.9) and workshop*communication (M=47.78) group were slightly higher than the control group (M=45.5), the gain math scores for the higher band of children across the groups could have been 'capped' due to the presence of a ceiling effect that was seen in the post test math scores. This subsequently affected the overall group mean scores of the three treatment groups. This would have attributed to the smaller gain in math scores seen in these groups.
2. The control group (n=40, and Band 1 n= 21) was comparatively smaller than the treatment group sizes as the overall participation rate from the selected centres for this group was lower, resulting in a narrower range of marks. As explained in the Chapter 3, this could have been due to the lack of incentives and motivation on parents' part to volunteer for this study. This smaller sample size also affected the spread and range of pre test and post test math scores within this group.
3. Due to the constraints faced by the investigator, the effect of a longer treatment period was also not tested, which could have had made some impact on parents' acquisition of skills in reinforcing and supporting children's learning at home.
4. Although the classes were randomly allocated to the different treatment groups, it is recognized that there could have been

different teaching approaches adopted by the different teachers as there was no standardized curriculum for the K2 classes. The 'teacher effect' across the different groups could not be fully controlled in terms of how each of these teachers conducted their teaching of math within their own classes. For example, the teaching activities carried out on a day to day basis by the teachers in the treatment groups during the period of intervention could have been influenced by the math kits. The teachers may have used the math kits for the purpose of daily classroom teaching and could also have 'extended' their teaching using these kits, and therefore children could have had more time with the math kits and scaffolding from their teachers, in addition to home support. It was also not possible to control or standardise what these teachers were doing in terms of teaching activities, such as giving children additional games and activity sheets to children for practice etc. across the different groups. This could have resulted in some children getting better 'practice opportunities' than others in mastering the concepts that were taught.

5. The investigator recognizes the limitations of not being able to standardize the teaching methods and lesson plans conducted by the teachers, even though teachers were a critical factor in determining the children's math learning and their gain math scores.

The next chapter will present findings on the parent dependent variables.

6. FINDINGS AND INTERPRETATIONS : PARENT DEPENDENT VARIABLES

Introduction

This chapter presents the data and findings on the dependent variables related to the parents. The first part of the chapter recaps the experimental hypotheses put forward, The second part of the chapter presents a description of the general profile of the groups at the beginning of the experiment. The third part is dedicated to testing the hypotheses and the statistical analysis of the experiment, and will present the inferential statistical analysis of the data using ANCOVA to compare the differences in the group means for the three key parent variables. This section is further divided into two parts, where the results of the analysis for all children in all four groups will be presented, followed by a presentation of the results according to the two subgroups of parents : primary/secondary and tertiary educated.

Hypotheses

The key research question guiding this study was :

Does a single type (parent workshop or communication) of school initiated involvement or a combination of types of school initiated Involvement (workshop and communication through newsletters) help to improve :

1. parent self efficacy and confidence in helping their child's mathematics learning at home
2. Parent encouragement and
3. Parent home involvement in children's math learning

For each of the treatment conditions, parents were expected to demonstrate increase in the gain scores in the above variables. However, each treatment condition was expected to influence parents' learning gains to different degrees.

Parents in the treatment groups were expected to perform better than those in the control group. The expected outcomes were as follows :

1. Greater improvement in all three parent variables in the treatment groups as compared to the control group.
2. The largest improvement in the parent variables to be seen in the workshop*communication group compared to the other two experimental treatments and control group.

The analysis of a two-factor ANOVA actually involves three distinct hypothesis tests. Specifically, the two-factor ANOVA will test for :

1. The mean difference between levels of the first factor communication (none and present)
2. The mean difference between levels of the second factor workshop (none and present)
3. The mean difference between levels of the combination of the two factors communication and workshop (none and present)

The first two hypotheses tests for the main effects of the two factors, hence, the null hypothesis for the main effects is that there are no differences among the levels of the factors (i.e. $H_0 : \mu_{\text{No Communication}} = \mu_{\text{communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$)

The third hypothesis is the test for the combined factors which examines the effects of the combination of the two factors together. The null hypothesis for this states that the combination of the two factors will have no effect on the children's math outcome :4 $H_0 : \mu_{\text{No Workshop*Communication}} = \mu_{\text{Workshop*Communication}})$.

General profile of Parents

Parent Education and SES (combined monthly income)

Parents with primary and secondary education formed 51% of the sample and the remaining 49% had Diploma/tertiary level education.

Table 6-1 Parent education level by experimental group

Method			n	Percent	Valid Percent
Control	Valid	Primary /secondary	22	45.8	55.0
		Tertiary	18	37.5	45.0
		Total	40	83.3	100.0
	Missing	System	8	16.7	
	Total		48	100.0	
Workshop	Valid	Primary /secondary	34	49.3	51.5
		Tertiary	32	46.4	48.5
		Total	66	95.7	100.0
	Missing	System	3	4.3	
	Total		69	100.0	
Communication only	Valid	Primary /secondary	41	54.7	59.4
		Tertiary	28	37.3	40.6
		Total	69	92.0	100.0
	Missing	System	6	8.0	
	Total		75	100.0	
Workshop &Communication	Valid	Primary /secondary	24	35.8	38.7
		Tertiary	38	56.7	61.3
		Total	62	92.5	100.0
	Missing	System	5	7.5	
	Total		67	100.0	

Within this sample, 35.7% were of the lower SES group, earning a combined monthly income of less than \$3,000, 52.9% were middle income, earning between \$3,000 and \$8,000 and 11.3% were of the high income group, earning above \$8,000.

Table 6-2 Combined monthly household income

		Frequency	Percent	Valid Percent
Valid	less than $3,000	85	32.8	35.7
	$3,000-$8,000	126	48.6	52.9
	above $8,000	27	10.4	11.3
	Total	238	91.9	100.0
Missing	no response	21	8.1	
Total		259	100.0	

A detailed breakdown of the profile of parents according to the different treatment groups are as follows :

Table 6-3 Combined monthly household income by experimental group

Method			N	%	Valid %
Control	Valid	less than $3,000	15	31.3	35.7
		$3,000-$8,000	23	47.9	54.8
		above $8,000	4	8.3	9.5
		Total	42	87.5	100.0
	Missing	no response	6	12.5	
	Total		48	100.0	
Workshop	Valid	less than $3,000	27	39.1	40.3
		$3,000-$8,000	35	50.7	52.2
		above $8,000	5	7.2	7.5
		Total	67	97.1	100.0
	Missing	no response	2	2.9	
	Total		69	100.0	
Communication only	Valid	less than $3,000	31	41.3	45.6
		$3,000-$8,000	30	40.0	44.1
		above $8,000	7	9.3	10.3
		Total	68	90.7	100.0
	Missing	no response	7	9.3	
	Total		75	100.0	
Workshop* Communication	Valid	less than $3,000	12	17.9	19.7
		$3,000-$8,000	38	56.7	62.3
		above $8,000	11	16.4	18.0
		Total	61	91.0	100.0
	Missing	no response	6	9.0	
	Total		67	100.0	

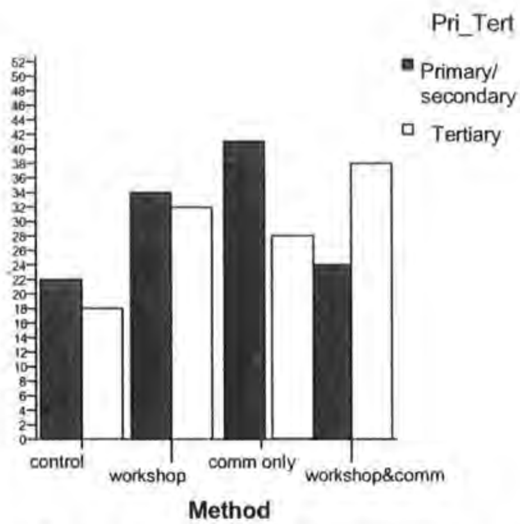


Figure 6-1 Parent Education level by experimental group

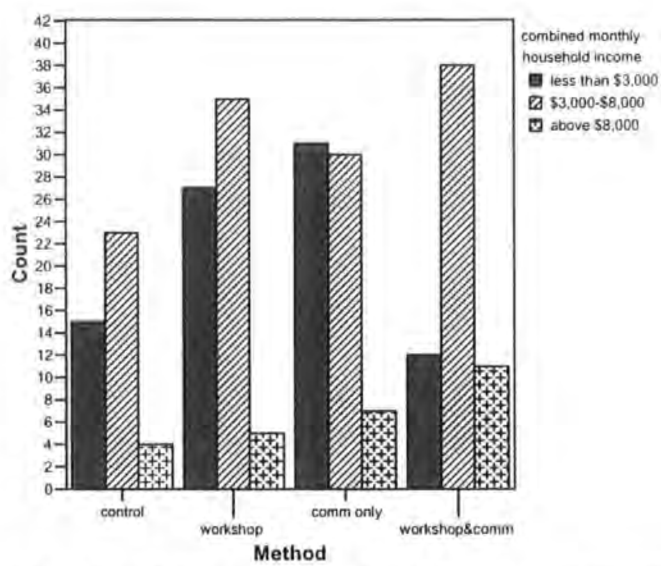


Figure 6-2 Combined monthly household income by experimental group

From Fig 6-1, the workshop*communication group had more parents with Tertiary /Diploma educated parents as compared to the other three groups, which had slightly more primary/secondary educated parents. Fig 6-2 shows that the workshop*communication group had more parents with a higher combined household income, with a majority within the $3,000-$8,000 range.

Exploratory Analysis of the Experiment

An exploratory analysis of the data prior to hypotheses testing was performed. This exploratory analysis helped to create a profile of the groups and to make initial observations of the groups' scores before and after the treatment.

Factor Analysis – Parent Involvement Instrument

The three dependent variables were measured using an instrument developed for this study that was adapted and modified from Hoover and Dempsey et al (2002).

The different subscales used to measure the dependent variables are presented as follows :

SubScale 1: Parent Efficacy (Confidence) for Helping Children Succeed in School

Using a six-point Likert-type response scale (1 = Disagree very strongly 2 = Disagree ; 3 = Disagree just a little; 4 = Agree just a little; 5 = Agree; 6 = Agree very strongly), participants were asked to respond to the following prompt: " Please indicate how much you Agree or Disagree with each of the following statements.. Please think about your child in this current school year as you consider each statement.

1. I have confidence in helping my child learn math
2. I am successful in helping my child learn.
3. I have a good understanding of the K2 maths curriculum
4. I know enough about the subjects of my child's homework to help him or her.
5. I am able to make use of everyday experiences (e.g. While at home or at the supermarket etc) to teach my child
6. I know how to explain things to my child about his or her homework.
7. I have enough time and energy to help my child with homework.
8. I have enough time and energy to communicate with my child's teacher.
9. I know how to help my child be ready for Primary One
10. I can make a big difference in helping my child adjust to Primary One
11. I know where to find resources to support my child's learning
12. I know how to use everyday materials to help my child learn

Subscale 2 : Parent-focused Role Construction – Parent Responsibility (Pres)

All belief items in the scale use a *disagree very strongly* to *agree very strongly* format: Disagree very strongly = 1, disagree = 2, disagree just a little = 3, agree just a little = 4, agree =5, agree very strongly = 6 . Total subscale scores range from 6 to 56. Higher scores indicate a stronger parent-focused role construct.

1. ...make sure my child understands his /her homework
2. ...communicate with my child's teacher regularly.
3. ...help my child with homework.
4. .....set family rules about doing homework
5. .....explain things to my child about his or her homework.
6. ...talk with my child what he /she is learning at the centre.

Subscale 3 :_Parent Self-Report of Parental Encouragement of Students (Penc)

Parents were asked to respond to the following prompt: "Parents and families do many different things when they are involved in their children's education. We would like to know how often you have done the following since the beginning of the school year for your K2 child on each item". using a six-point Likert-type scale (All items in the scale use a 6 point frequency response format: 1 = never; 2 = 1 or 2 times; 3 = 4 or 5 times; 4 = once a week; 5 = a few times a week; 6 = daily)

1. ... learn new things.
2. ...find new ways to do schoolwork when he or she gets stuck.
3. ...to stick with his or her homework until he or she finishes it.
4. ...make his or her homework fun.
5. ...how to find out more about things that interest him or her.

Sub scale 4 & 5 : Parent Choice of Involvement Activities (Pinv) and Self Report of Parental Reinforcement of Students

Participants were asked to respond to the following prompt: "Parent and families do many different things when they are involved in their children's education. We would like to know how often you have done the following since the beginning of the school year for your K2 child." Using a six-point, Likert-type scale (i.e., 1=Never, 2=Seldom, 3=Sometimes, 4=Often, 5= Very often 6=Always).

1. ...talk with your child about what he/she learns at the enter.
2. ...make sure this child's homework gets done
3. ..visit my child's classroom
4. ...attend Parent Teacher Conference meetings.
5. ...practice spelling, math or other skills with your child.

6. ...read with your child.
7. ....help your child with math homework
8. ...participate in parent workshops
9. ...wants to learn new things.
10. ...has a positive attitude about doing his or her homework.
11. ...keeps working on homework even when he or she doesn't feel like it.

A few iterations of factor analysis using principal component analysis of the 34 questionnaire items that were deemed to constitute indicators of the outcome variables were conducted to find the most appropriate model for grouping the principal components. Subsequently, one item, 'making homework fun' was omitted as it did not have a high score for any of the key components.

A total of five principal components were extracted. The criterion used to determine the number of factors was based on the variability of the items as represented by their eigenvalues. Those factors with eigenvalues greater than one were identified as the key factors.

Having reduced the data down to five key components, the next step was to classify the variables in a meaningful way. To do this, a promax rotation with Kaizer Normalisation was run on the principal components to obtain a clearer pattern of the factor loadings.

The scree plot in Fig 6.3 shows a 'break' in the elbow just before the 6th component, confirming that there are 5 principal components.

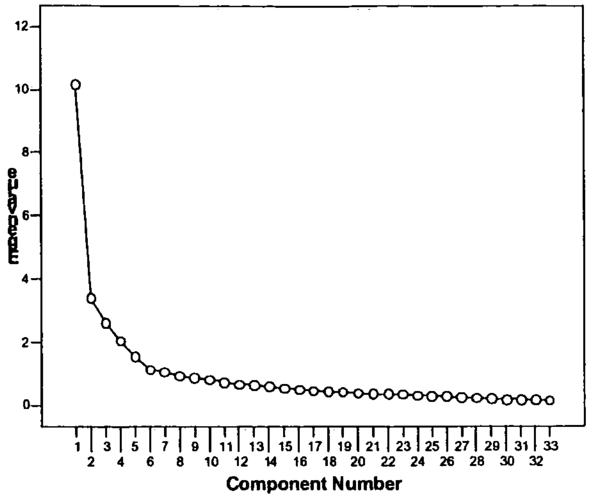


Figure 6-3 Scree plot

The first principal component accounts for nearly 31% of the variance, followed by 10% of the variance by the 2nd principal component. Together, the five principal components account for 59.7% of the total variance (Table 6-4).

Table 6-4 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings(a)
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10.151	30.762	30.762	10.151	30.762	30.762	8.760
2	3.383	10.251	41.013	3.383	10.251	41.013	6.016
3	2.608	7.902	48.915	2.608	7.902	48.915	5.523
4	2.026	6.140	55.055	2.026	6.140	55.055	4.821
5	1.528	4.632	59.686	1.528	4.632	59.686	2.407
6	1.127	3.416	63.103				
7	1.045	3.165	66.268				
8	.927	2.810	69.079				
9	.869	2.632	71.711				
10	.811	2.457	74.167				
11	.716	2.171	76.338				
12	.651	1.971	78.310				
13	.643	1.948	80.257				
14	.592	1.792	82.050				
15	.536	1.625	83.675				
16	.499	1.512	85.187				
17	.459	1.390	86.577				
18	.434	1.316	87.893				
19	.424	1.284	89.177				
20	.379	1.148	90.325				
21	.355	1.075	91.401				
22	.352	1.067	92.468				
23	.342	1.037	93.505				
24	.298	.902	94.407				
25	.284	.859	95.266				
26	.271	.821	96.087				
27	.235	.713	96.800				
28	.219	.664	97.464				
29	.202	.612	98.075				
30	.174	.526	98.601				
31	.170	.515	99.116				
32	.152	.462	99.578				
33	.139	.422	100.000				

Extraction Method: Principal Component Analysis.

The following pattern matrix shows the correlations between the variables and the components (Table 6-5).

Table 6-5 Matrix of correlations between variables and components

	Component 1	2	3	4	5
I. Parent Confidence / Efficacy					
• know how to help child prepare for P1	.907				
• success in helping child learn	.842				
• can make a difference in helping child adjust to P1	.832				
• Confidence to help child learn math	.821				
• enough time and energy to help with child's homework	.818				
• know where to find resources to support child's learning	.769				
• know how to explain things to my child about homework	.752				
• know how to use materials to help my child learn	.656				
• enough time and energy to communicate with teacher	.650				
• good understanding of math curriculum	.646				
• know enough about subjects of child's homework	.627				
• able to use everyday experiences to teach my child	.624				
II. Parent Encouragement and Reinforcement					
1. reinforce child to learn new things		.798			
2. find new ways to do schoolwork		.763			
3. reinforce child's positive attitude about his homework		.749			
4. find out more about what interests child		.739			
5. reinforce persistence in homework completion		.700			
6. stick with homework until he/she finishes it		.695			
7. encourage child to learn new things		.635			
III. Parent Role / Responsibility					
1. explain things to child about homework			.798		
2. talk with child what he/she is learning at school			.783		
3. make sure child understands homework			.757		
4. help with child's homework			.739		
5. communicate with child's teacher			.738		
6. set family rules about doing homework			.656		
IV. Home Involvement					
1. make sure homework gets done				.768	
2. help child with math homework				.754	
3. practice spelling, math or other skills with child				.735	
4. talk with child what he/she is learning at school				.657	
5. read with your child				.631	
V. School Involvement					
1. participate in parent workshops					.858
2. attend PTC meetings					.854
3. visit child's classroom					.407

Extraction Method: Principal Component Analysis. Rotation Method: Promax with Kaiser Normalization.

a Rotation converged in 6 iterations.

The scores for the various items are all above 0.40 and mostly much higher, and have been sorted into the 5 key components, which were then re-named as

1. Parent Confidence /Efficacy
2. Parent Encouragement
3. Parent Role /Responsibility
4. Home Involvement
5. School Involvement

The internal consistency (Cronbach's alpha) of the 5 factors are as follows :

Table 6-6 Cronbach's alpha for parent factors and math assessment

Key factors	Cronbach's alpha	Total Max. score
1. Parent Confidence	0.932	72
2. Parent Encouragement	0.863	42
3. Parent Role /Responsibility	0.878	36
4. Home Involvement	0.779	30
5. School involvement[38]	0.537	18

The alpha coefficient for all 6 variables were sufficiently high (above 0.7) except for School Involvement.

For the purpose of addressing the research questions of this study, three dependent parent variables (Confidence, Encouragement and Home Involvement) were selected for further statistical analysis. These three variables were deemed to be more pertinent variables to that could help to enhance children's math learning at home. The total scores of the pre- and post-test of these factors were computed by summing the scores of the individual items in each of the category. The gain score (post-pre) was then computed as the dependent variable for further ANOVA tests to compare the difference in group means between the different experimental groups.

[38] School Involvement and parent role /responsibility were not included as a dependent variables for this study

Preparation for Data Analysis

Categorising data for analysis purposes

Some of the data collected were regrouped into a smaller number of categories. This categorization was necessary for group comparisons, analysis of frequencies and other types of analysis. The categories are described below :

- Definition of Gain Scores

  To minimize any problems in the analysis resulting from initial differences found in the groups, the parent dependent variables were measured using the absolute difference between the post-test and pre-test math scores.

  a. the **absolute difference** between the post-test and pre-test DV score was calculated by :

     a. Δ DV = (Post test score) – (Pre test score)

- Subgroups by Parents' Education level

  The original four categories of parent education level (1 =Primary, 2=Secondary, 3=Diploma, 4=Tertiary) were re-grouped into two groups : 1=Primary/Secondary and 2=Diploma/Tertiary) so as to preempt the small n in the original grouping

- Treatment conditions were dummy coded into the following groups for further ANOVA analyses and hypotheses testing :

  a. Groups with and without the communication condition
  b. Groups with and without the workshop condition

Descriptive Analysis of Pre, Post and Gain of Parent Dependent Variables

This section will present data that address the following question :

1. Does a single type of parent involvement, Parental Education workshops (X_2) or communication (X_3) or a combination of the 2 types of Parent Involvement (X_4) help to improve :
   - Parent self efficacy and confidence in becoming involved in their child's mathematics learning

- Parental encouragement of children's learning at home
- Parental Home Involvement

Testing Hypotheses related to gains in parent dependent variables (DVs)

The experimental hypothesis was that the increase in gain in parent variables would be higher for the treatment groups than that of the control group. To test the hypotheses, the investigator had at her disposal the following sources of information :

1. Descriptive values of Pre, Post and gain scores of the parent DVs
2. Feedback from parents from the three treatment groups

Table 6-7 Summary of Parent Variables (Pre, Post and Gain scores) by experimental grouping and education level[39]

Method	Parent Variable	Parent Education Level								
		Primary/secondary			Tertiary			Total		
		N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Control	PreConfTotal	22	46.41	11.79	17	53.82	5.04	39	49.64	10.07
	PostConfTotal	22	50.14	11.28	16	52.25	11.99	38	51.03	11.47
	Gain Parent Confidence	22	3.73	7.91	15	-1.07	10.42	37	1.78	9.19
	PreEncTotal	22	28.59	8.41	17	29.24	6.08	39	28.87	7.40
	PosEncTotal	22	28.41	5.89	16	27.94	5.22	38	28.21	5.55
	Gain Parent Enc	22	-.18	7.99	15	-.47	5.01	37	-.30	6.86
	PreHITotal	22	21.73	5.78	17	23.59	3.62	39	22.54	4.99
	PosHITotal	22	22.27	4.54	16	22.63	5.25	38	22.42	4.79
	Gain parent home involvement	22	.55	3.89	15	-1.07	4.33	37	-.11	4.09
Workshop	PreConfTotal	31	49.39	13.21	31	51.13	8.75	62	50.26	11.15
	PostConfTotal	30	54.47	6.50	27	53.04	7.20	57	53.79	6.82
	Gain Parent Confidence	27	5.19	11.35	26	2.19	6.09	53	3.72	9.20
	PreEncTotal	31	27.65	5.70	31	29.29	6.12	62	28.47	5.92
	PosEncTotal	31	30.32	5.69	27	29.44	5.71	58	29.91	5.66
	Gain Parent Enc	28	2.14	5.53	26	.35	4.37	54	1.28	5.04
	PreHITotal	31	22.71	4.32	31	21.52	4.58	62	22.11	4.46
	PosHITotal	31	23.81	3.75	27	22.52	3.61	58	23.21	3.71
	Gain parent home involvement	28	.71	3.16	26	1.15	3.09	54	.93	3.11

[39] Figures in tables may not add up to the totals due to missing values in the parents' pre and post responses.

Method	Parent Variable	Parent Education Level								
		Primary/Secondary			Tertiary			Total		
		N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Communication	PreConfTotal	38	46.53	8.54	26	48.88	10.03	64	47.48	9.17
	PostConfTotal	37	48.86	10.45	24	50.92	7.98	61	49.67	9.54
	Gain Parent Confidence	34	2.76	8.72	22	3.09	9.27	56	2.89	8.86
	PreEncTotal	37	29.41	6.09	26	29.50	5.42	63	29.44	5.78
	PosEncTotal	36	27.00	5.87	24	30.50	5.92	60	28.40	6.09
	Gain Parent Enc	33	-2.00	6.26	22	1.00	5.69	55	-.80	6.17
	PreHITotal	38	21.50	5.37	26	21.08	5.35	64	21.33	5.32
	PosHITotal	37	22.70	4.03	24	21.75	4.72	61	22.33	4.30
	Gain parent home involvement	34	1.68	4.41	22	.59	5.06	56	1.25	4.66
Workshop*Communication	PreConfTotal	22	49.05	9.62	36	50.86	11.11	58	50.17	10.52
	PostConfTotal	21	53.29	7.36	32	53.81	6.27	53	53.60	6.65
	Gain Parent Confidence	19	2.11	6.01	30	2.53	9.01	49	2.37	7.91
	PreEncTotal	22	29.82	4.51	36	31.28	5.43	58	30.72	5.11
	PosEncTotal	21	31.10	5.86	32	30.69	4.46	53	30.85	5.01
	Gain Parent Enc	19	.53	4.50	30	.13	6.51	49	.29	5.76
	PreHITotal	22	23.23	2.84	36	22.06	3.92	58	22.50	3.57
	PosHITotal	21	23.86	2.59	32	22.53	3.47	53	23.06	3.20
	Gain parent home involvement	19	.16	3.56	30	.37	3.43	49	.29	3.45

Parent Confidence

The highest post parent confidence score (for all parents) were found in the workshop group (M= 53.79, SD=6.82), followed by the workshop*communication group (M= 53.60, SD= 6.65) (Figure 6-4).

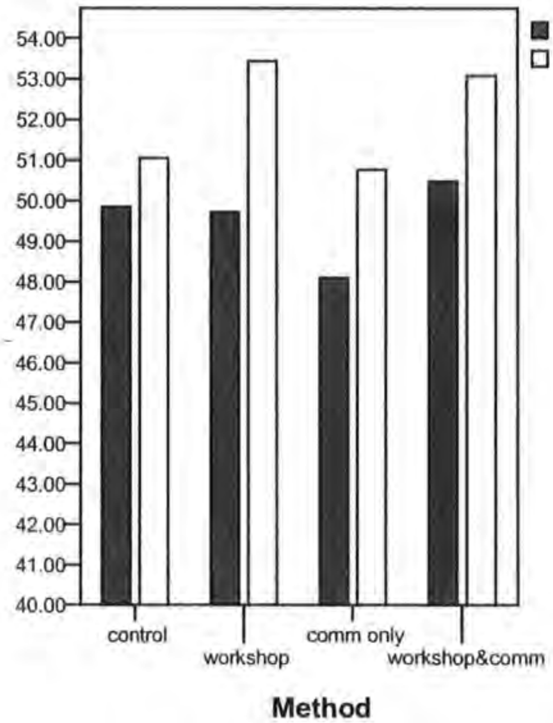


Figure 6-4 Pre, Post Parent Confidence by experimental groups

However, it was noted that the pre Parent Confidence score for the workshop*communication group was highest as compared to the other three groups. The largest gain (post-pre) in parent confidence was observed in the workshop group among parents with primary/secondary education (M=5.19, SD = 11.35) in Table 6-7. Among the tertiary educated parents, the highest gain score was found in the communication group (M=2.53 , SD = 9.01) followed by the workshop*communication group : (M=5.19, SD = 11.35) (Figure 6-5).

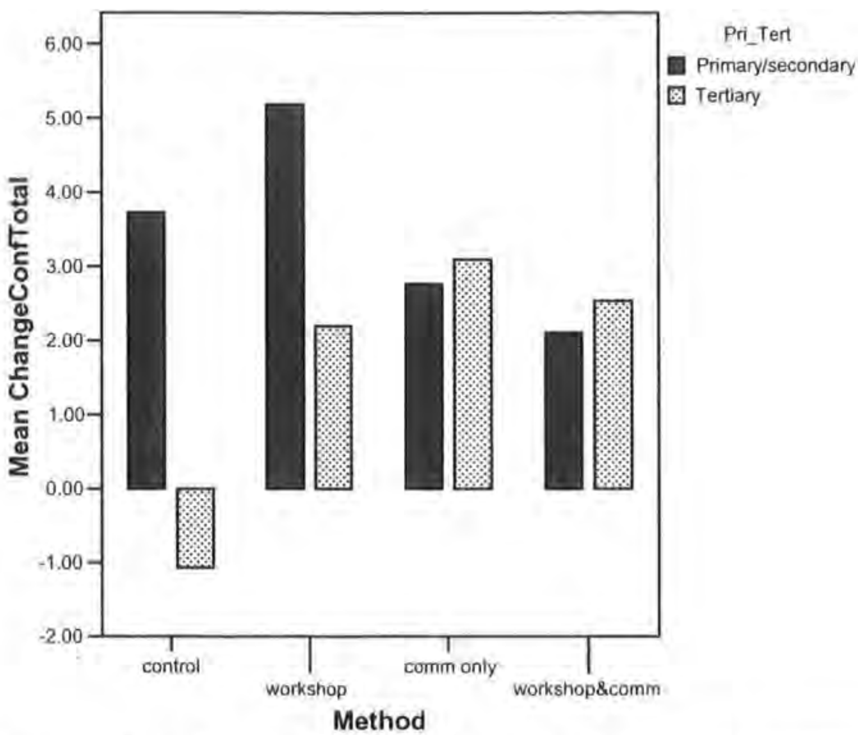


Figure 6-5 Gain Parent Confidence by parent education level and experimental groups

Parent Encouragement

For parent encouragement, the highest post group mean scores were observed seen in the workshop*communication (M=30.85, SD = 5.01 and workshop groups (M=29.91, SD = 5.66). For the control and communication groups, the post scores were lower than the pre scores.

Highest gain in parent encouragement was seen among the Primary/secondary educated parents in the workshop group, followed by the Tertiary educated parents in the communication group (Figure 6-7). Negative gain score was observed among the primary educated parents in the communication group.

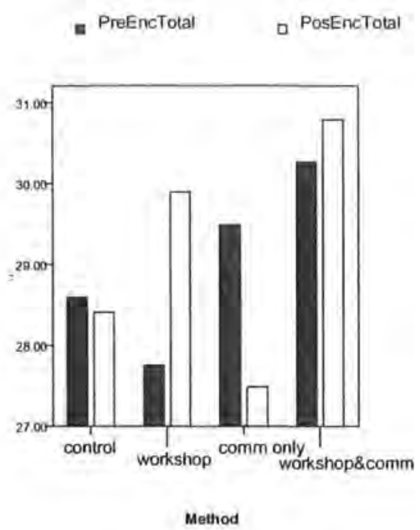


Figure 6-6 Pre-Post Parent Encouragement by experimental groups

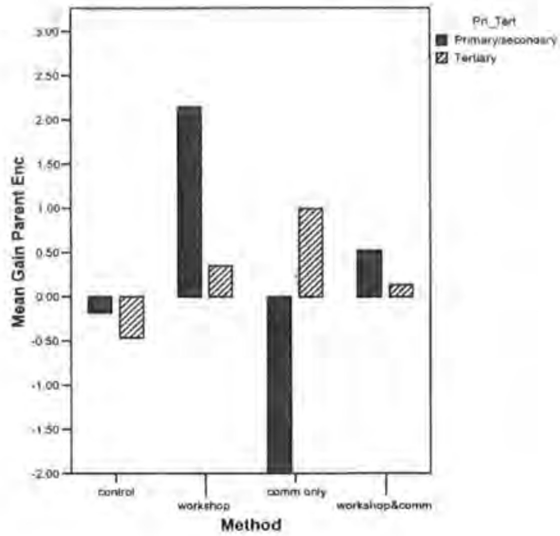


Figure 6-7 Gain in Parent Encouragement by Parent Education Level

Small gains in parent encouragement were seen in the workshop group (M=1.28, SD = 5.04) and the workshop*communication (M=0.28, SD=5.76) group (Table 6-7). However, the workshop*communication group also had the highest pre parent encouragement score.

Parent Home Involvement

The post parent home involvement score was highest in the workshop group (M=23.21, SD = 3.71), followed by the workshop*communication group (M=23.06, SD = 3.2) (Fig 6-8 and Table 6-7). The post scores were lowest in the control group (M=22.42, SD= 4.79).

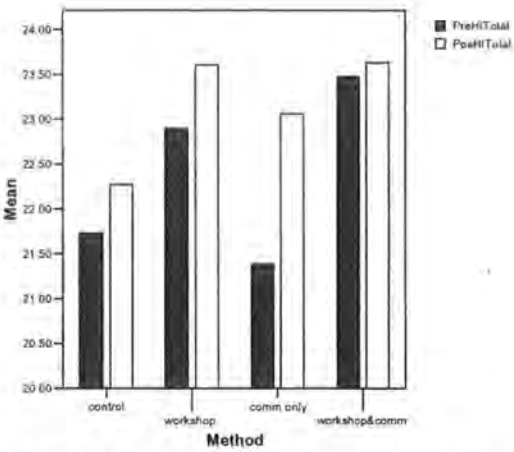


Figure 6-8 Pre,Post Parent Home Involvement by parent education level and experimental groups

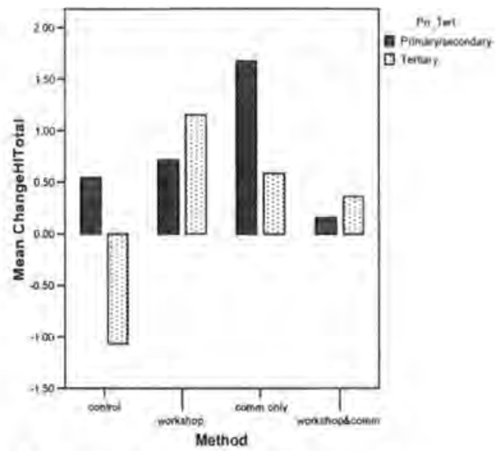


Figure 6-9 Gain Parent Home Involvement by parent education level and experimental groups

The gain score in home involvement was highest in the communication group among parents with primary /secondary education, (M=1.68, SD = 4.41) (Figure 6-9), followed by the workshop group (M=0.71, SD = 3.16), and was lowest in the workshop*communication group. The comparatively low gain score seen in the workshop*communication group could have been due to its relatively higher pre score as compared to the other groups. Primary educated parents scored highest on gain scores in home involvement in the workshop group, compared to the communication and workshop*communication groups.

Effect Size for Gain scores

For the purpose of comparing the gain scores of the three parental dependent variables across the different treatment groups, the effect size for each of the dependent variable were computed and are presented in the following Table 6-8.

In each analysis, the two groups being compared are the treatment and control groups. By convention the subtraction, $M_{1\ \text{Treatment group}} - M_{2\ \text{Control}}$

group, (where M stands for the group mean of the gain score) is done so that the difference is positive if it is in the direction of *improvement* or in the predicted direction and negative if in the direction of *deterioration* or opposite to the predicted direction.

The value of Cohen's d , was calculated using the means and standard deviations of two groups (treatment and control) :

Cohen's $d = M_1 - M_2 / \sigma_{pooled}$, where $\sigma_{pooled} = \sigma\ [(\sigma_{1treatment}{}^2 + \sigma_{2\ Control}{}^2) / 2]$

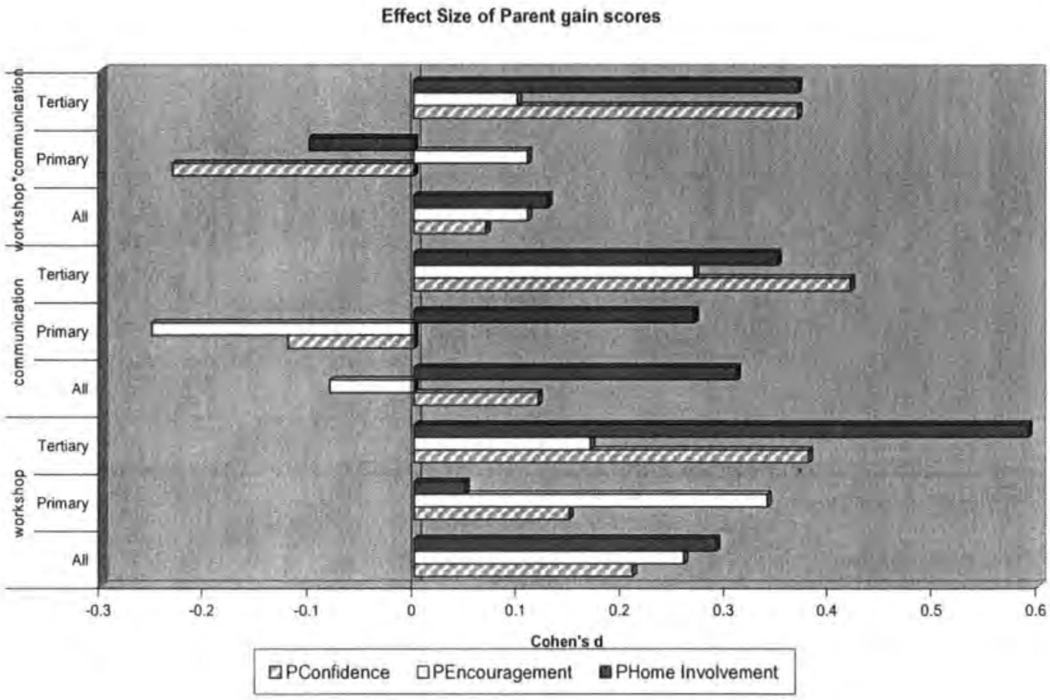
Effect sizes (Cohen's d)[40] for the different groups are summarized in Table 6-8.

Table 6-8 Effect Size of parent variables for the three treatment groups and parent education levels

Experimental group		Effect size		
		PConfidence	PEncouragement	PHome Involvement
workshop	All	0.21	0.26	0.29
	Primary	0.15	0.34	0.05
	Tertiary	0.38	0.17	0.59
communication	All	0.12	-0.08	0.31
	Primary	-0.12	-0.25	0.27
	Tertiary	0.42	0.27	0.35
workshop*communication	All	0.07	0.11	0.13
	Primary	-0.23	0.11	-0.1
	Tertiary	0.37	0.1	0.37

40 For Table of Effect Size, please refer to Appendix N, pp. 342

Figure 6-10 Effect Size of parent dependent variables by experimental group and parent education level



The bar chart in Fig 6-10 represents the effect sizes of the different parent variables across the three experimental groups.

- **Parent Home Involvement**

In terms of effect size, the highest gain in home involvement was observed in the workshop group among the tertiary educated parents (ES = 0.59, medium size). Small effect sizes (0.31) in parent home involvement were observed in the communication group (all education levels).

The effect size for gains in parent home involvement (ES=0.13) was small for the workshop*communication group (all education levels). Within this group, the effect size for gain in home involvement was (small) negative (-

0.1) for parents with primary/secondary education but the effect size was positive and stronger among the tertiary educated parents (0.37) in the same group.

- **Parent Encouragement**

Effect size for gain in parent encouragement were very small for parents in the workshop*communication group (0.11).

In the workshop group, parents with primary/secondary education showed the highest effect size in gains in parent encouragement (ES=0.34), which was higher than parents with tertiary education (ES=0.17). Negative gains in parent encouragement were observed in the communication group among parents with primary/secondary education. Gains in parent encouragement for parents in the workshop*communication group had small effect sizes for both the primary and tertiary educated parents (ES = 0.11 and 0.1 respectively).

- **Parent Confidence**

The largest effect size for gains in parent confidence were seen among tertiary educated parents across all three experimental groups: communication (ES=0.42), workshop (ES=0.38) and workshop*communication (ES=0.37). Negative (small) effect size were observed among parents with primary /secondary educated parents in both the communication (ES = -0.12) and workshop*communication groups (ES =-0.23).

In summary, parents (all) in the workshop group showed positive effect sizes for gains in all three parent variables (0.21,0.26, 0.29).

The notably higher effect size for gain in parent home involvement and confidence for parents in the workshop group could perhaps be explained by the fact that the interactions and support given by the teachers during the workshops had helped to improve parents' confidence and beliefs in relation to their roles in encouraging, and being involved in their children's learning at home, particularly for those with higher education.

Tertiary educated parents appeared to have made better gains in home involvement and confidence in terms of the comparatively larger effect size as compared to parents with primary /secondary education in all three experimental groups. Parents with primary education on the other hand showed the highest effect size (ES =0.34) in gain score in parent encouragement in the workshop group.

For parents in the communication group, those with tertiary /diploma education showed positive gains in confidence (0.42), encouragement (0.27) and home involvement (0.35), but parents with primary /secondary education showed a decrease in confidence and encouragement, but an increase in home involvement (0.27). It is possible that the same treatment could have been received differently by different groups. It may be that less confident parents (less educated) might find something threatening that higher educated parents find helpful. Furthermore, even though it appears that the newsletters could have resulted in a positive impact on parents' home involvement for the parents with higher education, it is not possible to ascertain whether these gains were facilitated by the newsletters itself or by some other factors, such as the teachers, who could have made a difference in explaining and encouraging parents to be more involved at home with their children's learning.

Univariate Analysis of Parent Confidence

All subjects

The error bar charts (Fig 6-11) for change parent confidence show an overlap across the four treatment groups, indicating that the difference in means between the groups were not significant.

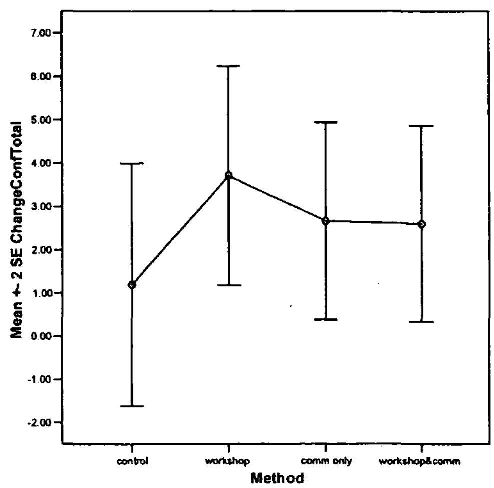


Figure 6-11 Means plots for gain Parent Confidence

A positive gain score for parent confidence was seen in all groups, with the highest seen in the workshop group (M=3.72, SD= 9.2),followed by the communication group (M=2.66, SD= 8.74). (Table 6-9).

Table 6-9 Group means for Gain in Parent Confidence with PreConfidence as covariate

Method	Mean	Std. Deviation	N
Control	1.20	8.98	41
Workshop	3.72	9.20	53
Communication only	2.66	8.74	59
Workshop*Communication	2.60	8.00	50
Total	2.63	8.71	203

Table 6-10 Levene's Test of Equality of Error Variances(a)

F	df1	df2	Sig.
2.314	3	199	.077

Levene's Test of the null hypothesis confirms that the error variance of the dependent variable is equal across groups (Table 6-10).

Table 6-11 Test of Between-subjects effects with Preconfidence as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreConf	5099.65	1.00	5099.65	100.06	.000	.336
Exptmethod	180.81	3.00	60.27	1.18	.317	.018
Error	10090.76	198.00	50.96			
Corrected Total	15337.55	202.00				

a R Squared = .342 (Adjusted R Squared = .329)

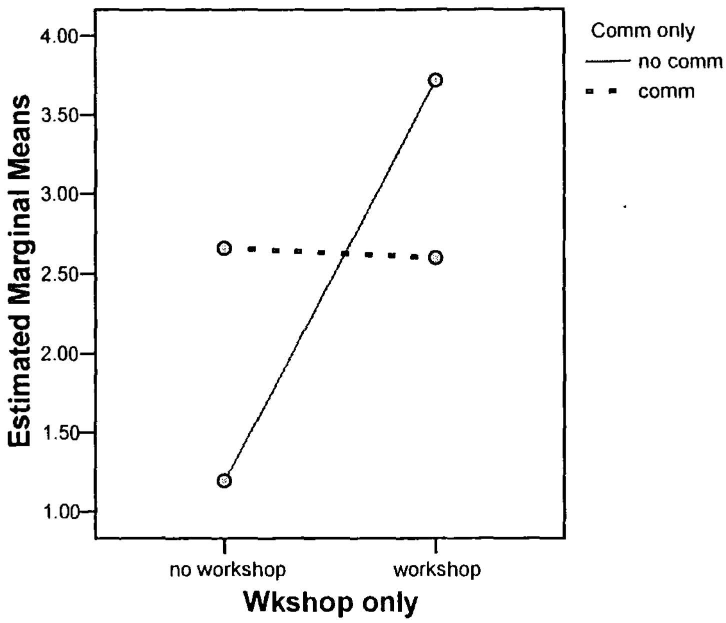
The ANOVA analysis (Table 6-11) showed that the treatment condition (Experiment method) did not have a significant effect on parent Confidence, $F(3,198) = 1.18$, $p > .05$.

Interaction Effects

In order to obtain the means plots of the two treatment conditions (workshop and communication), a separate ANOVA analysis was run using workshop and communication conditions as the fixed factors.

From the profile plots in Fig 6-12, an interaction effect was present between the workshop and communication condition. Parents in the workshop group without the communication condition showed a higher increase in parent confidence ($M = 3.72$, $SD = 9.2$) as compared to the groups with the communication condition.

Figure 6-12 Means plots of Gain in Parent Confidence with and without workshop condition (without covariate)



The control group (no workshop and no communication) had the lowest group mean (Mean = 1.2, SD = 8.98) (Table 6-12). What this could mean is that the communication condition appeared to have lowered the effect of the workshop condition on parent confidence.

Table 6-12 Group Means for Gain in Parent Confidence (No workshop by workshop) without covariate

Workshop only	Communication only	Mean	Std. Deviation	N
no Workshop	no Communication	1.20	8.98	41
	Communication	2.66	8.74	59
	Total	2.06	8.82	100
Workshop	no Communication	3.72	9.20	53
	Communication	2.60	8.00	50
	Total	3.17	8.61	103
Total	no Communication	2.62	9.14	94
	Communication	2.63	8.37	109
	Total	2.63	8.71	203

This could perhaps be due to a result of the newsletters having created some confusion among parents, resulting in a lower gain in parent confidence. Another reason to explain a lower gain in parent confidence in the combined condition group could be that the Workshop*communication group had the highest pre score as compared to the other groups. As seen from the means plots, the effect of the workshop condition did appear to be stronger than the communication condition.

However, as seen in Table 6.13, the combined conditions was not significant, Hence, the interaction effect could have been due to chance. From the ANOVA Table (Table 6-13), both the main and interaction effects of workshop and communication as well as the combined conditions were not statistically significant.

Table 6-13 Tests of Between-Subjects Effects with PreConfidence as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreConf	5099.65	1.00	5099.65	100.06	.00	.34
Workshop	164.33	1.00	164.33	3.22	.07	.02
Communication	.36	1.00	.36	.01	.93	.00
Workshop * Communication	19.83	1.00	19.83	.39	.53	.00
Error	10090.76	198.00	50.96			
Corrected Total	15337.55	202.00				

a R Squared = .342 (Adjusted R Squared = .329)

From Table 6-14, the pair wise comparisons show that the group differences for change in parent confidence between the different groups were not significant.

Table 6-14 Pair wise Comparisons for Gain Parent Confidence with PreConfidence as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	-2.450	1.485	.603
	Communication only	-.547	1.454	1.000
	Workshop*Communication	-1.733	1.504	1.000
Workshop	Control	2.450	1.485	.603
	Communication only	1.903	1.354	.968
	Workshop*Communication	.717	1.408	1.000
Communication only	Control	.547	1.454	1.000
	Workshop	-1.903	1.354	.968
	Workshop*Communication	-1.186	1.378	1.000
Workshop*Communication	Control	1.733	1.504	1.000
	Workshop	-.717	1.408	1.000
	Communication only	1.186	1.378	1.000

Based on estimated marginal means a Adjustment for multiple comparisons: Bonferroni.

Parents with Primary & Secondary Education

This section will discuss the results with a focus on the group of parents with primary/secondary education using the same pattern of analysis. From the error mean graph shown in Fig 6.13, there is an obvious overlap across all four groups, indicating that the differences in group means between groups is not significant.

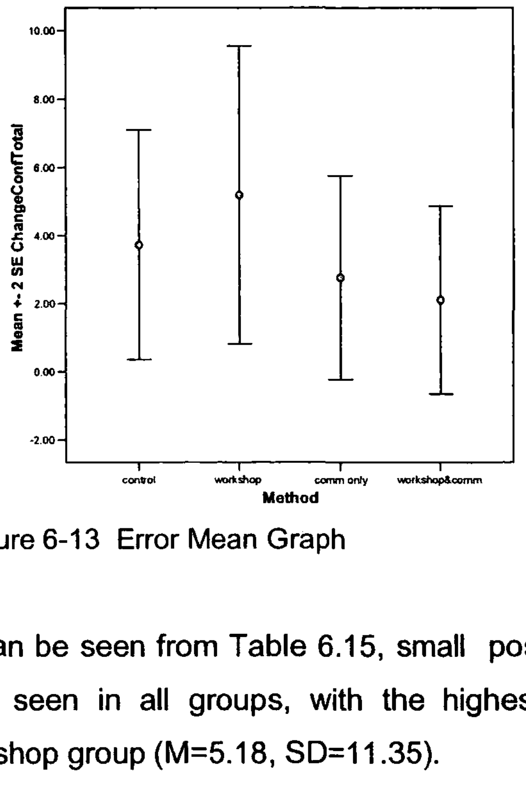


Figure 6-13 Error Mean Graph

As can be seen from Table 6.15, small positive gains in parent confidence were seen in all groups, with the highest increase being found in the workshop group (M=5.18, SD=11.35).

Table 6-15 Group Means for Gain in parent confidence with PreConfidence as covariate – parents with primary /secondary education

Method	Mean	Std. Deviation	N
Control	3.7273	7.91130	22
Workshop	5.1852	11.35117	27
Communication only	2.7647	8.71800	34
Workshop*Communication	2.1053	6.00828	19
Total	3.4902	8.87509	102

Table 6-16 Levene's Test of Equality of Error Variances(a)

F	df1	df2	Sig.
.826	3	98	.483

Levene's Tests of the null hypothesis confirm that the error variance of the dependent variable is equal across groups (Table 6-16).

Table 6-17 Test of Between-Subjects effects with preconfidence as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreConf	2698.761	1	2698.761	51.093	.000	.345
Exptmethod	173.552	3	57.851	1.095	.355	.033
Error	5123.584	97	52.820			
Total	9198.000	102				
Corrected Total	7955.490	101				

a R Squared = .356 (Adjusted R Squared = .329)

Table 6-17 shows that the treatment did not have a significant effect on change in confidence. $F_{3,97}=1.09$, $p>.05$.

For both sets of ANOVA analyses (with covariate), the difference between the different groups were not significant and the experimental conditions, including the two main conditions, workshop, communication and the combined conditions did not have a significant effect on parent confidence. Hence, the null hypotheses cannot be rejected.

Table 6-18 Pairwise Comparisons for Gain Parent Confidence with pre confidence as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	-2.703	2.095	1.000
	Communication only	.533	1.989	1.000
	Workshop*Communication	-.180	2.290	1.000
Workshop	Control	2.703	2.095	1.000
	Communication only	3.236	1.877	.527
	Workshop*Communication	2.522	2.178	1.000
Communication only	Control	-.533	1.989	1.000
	Workshop	-3.236	1.877	.527
	Workshop*Communication	-.713	2.091	1.000
Workshop*Communication	Control	.180	2.290	1.000
	Workshop	-2.522	2.178	1.000
	Communication only	.713	2.091	1.000

Based on estimated marginal means a Adjustment for multiple comparisons: Bonferroni.

The difference in group means among the different groups were not found to be significant (Table 6-18).

Parent Encouragement

In this section, the same pattern of analysis performed for Parent Confidence will be carried out and presented for Gain in Parent Encouragement, beginning with all parents.

All Parents

The error bar charts (Figure 6.14) show an overlap especially between the control, communication and workshop*communication groups, indicating that the difference in group means of these groups are unlikely to be significant.

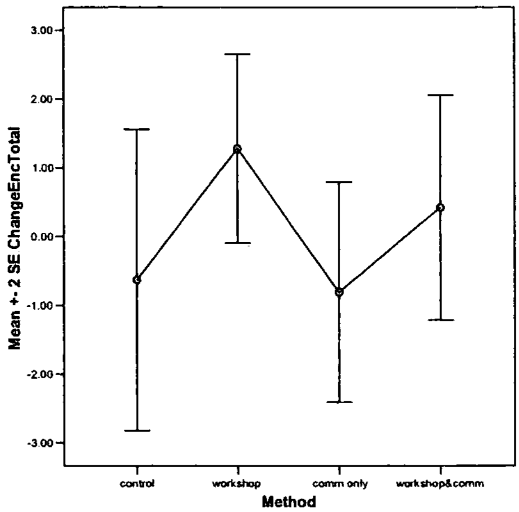


Figure 6-14 Error Mean Graph for Gain in parent Encouragement – All parents

Small positive gain in parent encouragement were seen in the workshop and workshop*communication groups (Table 6-19). The highest change was found in the workshop group (M=1.28, SD= 5.04)

Table 6-19 Group means for gain in parent encouragement with pre encouragement as covariate

Method	Mean	Std. Deviation	N
Control	-.63	7.01	41
Workshop	1.28	5.04	54
Communication only	-.81	6.09	58
Workshop*Communication	.42	5.78	50
Total	.08	5.98	203

Table 6-20 Levene's Test of Equality of Error Variances

F	df1	df2	Sig.
.706	3	199	.549

Levene's Test of the null hypothesis confirms that the error variance of the dependent variable is equal across groups (Table 6-20).

Table 6-21 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreEnc	2171.237	1	2171.237	87.911	.000	.307
Exptmethod	115.880	3	38.627	1.564	.199	.023
Error	4890.202	198	24.698			
Corrected Total	7211.576	202				

a R Squared = .322 (Adjusted R Squared = .308)

The ANOVA Table (Table 6.21) shows that the treatment condition did not have a significant effect on gain in parent encouragement, $F(3,198) = 1.56$, $p > .05$.

Interaction Effects

The ANOVA analysis (Table 6-22) showed that the workshop condition had a significant effect on parent encouragement, $F(1,198) = 4.66$, $p < .05$, Partial eta squared = .023, representing a small effect. However the effect of communication condition was not statistically significant. No interaction effect on parent encouragement was observed.

Table 6-22 Tests of Between-Subjects Effects for Gain Parent Enc with covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreEnc	2171.237	1	2171.237	87.911	.000	.307
Workshop	115.121	1	115.121	4.661	.032	.023
Communication	1.492	1	1.492	.060	.806	.000
Workshop * Communication	.010	1	.010	.000	.984	.000

a R Squared = .322 (Adjusted R Squared = .308)

From the means profile plots (Fig 6-15), the Workshop condition (main effect) is stronger than the communication condition on gain in parent encouragement. However, this effect as shown by the eta squared = .023 is small.

Table 6-23 Dependent Variable: Gain Parent Encouragement without covariate

Workshop only	Communication only	Mean	Std. Deviation	N
no Workshop	no Communication	-.63	7.01	41
	Communication	-.81	6.09	58
	Total	-.74	6.45	99
Workshop	no Communication	1.28	5.04	54
	Communication	.42	5.78	50
	Total	.87	5.40	104
Total	no Communication	.45	6.01	95
	Communication	-.24	5.95	108
	Total	.08	5.98	203

The highest gain in parent encouragement was observed in the workshop only group (mean =1.28, SD = 5.04) (Table 6-23).

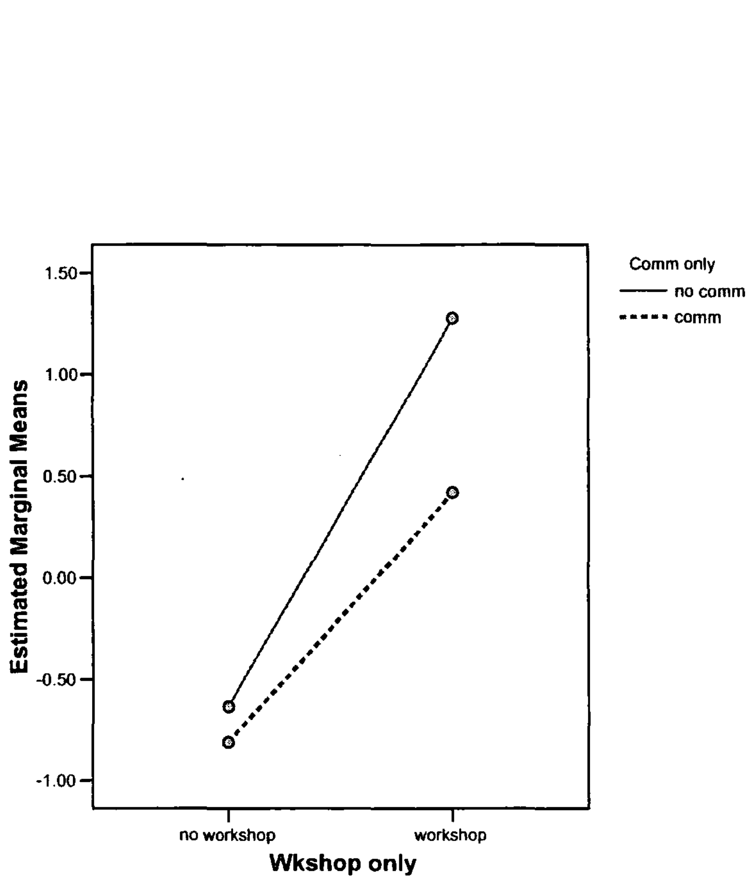


Figure 6-15 Means plots of Gain in Parent Encouragement with and without workshop condition (without covariate)

The difference in group means between the treatment groups and the control group were not significant (Table 6-24).

Table 6-24 Pairwise Comparisons for Gain Parent Encouragement with Pre Encouragement as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	-1.505	1.030	.875
	Communication only	-.160	1.015	1.000
	Workshop*Communication	-1.693	1.049	.650
Workshop	Control	1.505	1.030	.875
	Communication only	1.345	.943	.932
	Workshop*Communication	-.188	.982	1.000
Communication only	Control	.160	1.015	1.000
	Workshop	-1.345	.943	.932
	Workshop*Communication	-1.533	.960	.670
Workshop*Communication	Control	1.693	1.049	.650
	Workshop	.188	.982	1.000
	Communication only	1.533	.960	.670

Based on estimated marginal means a Adjustment for multiple comparisons: Bonferroni.

Parents with primary /secondary education

For parents with primary /secondary education, the only group that had an increase in change in encouragement were parents in the workshop group (M=2.14, SD=5.53) (Table 6-25).

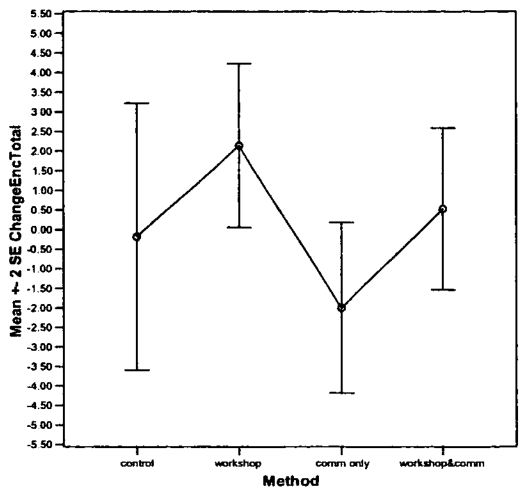


Figure 6-16 Error Mean Graph for Gain in Parent Encouragement

The error bar charts (Figure 6-16) show an overlap among the control, communication and workshop*communication groups. There was no overlap between the workshop and communication group, indicating that the difference in group means of these groups could be significant.

Table 6-25 Group Means for Gain in parent encouragement (Parents with Primary/Secondary education)

Method	Mean	Std. Deviation	N
Control	-.18	7.99	22
Workshop	2.14	5.53	28
Communication only	-2.00	6.26	33
Workshop*Communication	.53	4.50	19
Total	.00	6.34	102

Negative gains were seen in the control and communication groups (Table 6-25).

Table 6-26 Levene's Test of Equality of Error Variances(a) Dependent Variable: ChangeEncTotal

F	df1	df2	Sig.
.098	3	98	.961

Levene's Test of the null hypothesis confirms that the error variance of the dependent variable is equal across groups (Table 6-26).

Table 6-27 Tests of Between-Subjects Effects : ChangeEncTotal with pre encouragement as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreEnc	1253.00	1.00	1253.00	47.96	.000	.331
Exptmethod	189.19	3.00	63.06	2.41	.071	.069
Error	2534.44	97.00	26.13			
Corrected Total	4054.00	101.00				

a R Squared = .375 (Adjusted R Squared = .349)

The ANOVA Table (Table 6-27) showed that the treatment method did not have a significant effect on the change in parental encouragement (F (3,97) = 2.41, p> .05) Hence, the null hypotheses cannot be rejected.

Table 6-28 Pairwise Comparisons for Gain Parent Encouragement with pre encouragement as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Workshop	Control	1.856	1.458	1.000
	Communication	3.176	1.321	.109
	Workshop*Communication	.215	1.533	1.000
Communication	Control	-1.320	1.409	1.000
Workshop*Communication	Control	1.641	1.607	1.000
	Communication	2.960	1.473	.284

Based on estimated marginal means a Adjustment for multiple comparisons: Bonferroni.

The difference between the group means between the groups were not significant (Table 6-28).

Parent Home Involvement

All subjects

Very small positive gain scores for parent home involvement were seen in all groups, with the highest seen in the communication group (M=1.02, SD= 4.74),followed by the workshop group (M=.93, SD=3.11) (Table 6-29).

Table 6-29 Dependent Variable: Gain parent home involvement with preHI as covariate

Method	Mean	Std. Deviation	N
Control	.20	4.27	41
Workshop	.93	3.11	54
Communication only	1.02	4.74	59
Workshop*Communication	.26	3.42	50
Total	.64	3.93	204

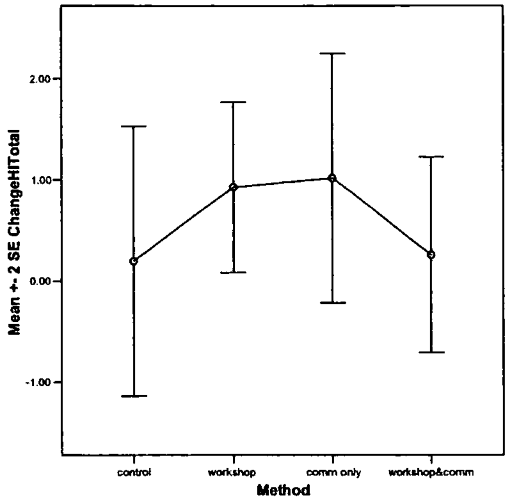


Figure 6-17 Error Mean Graph for Gain in Parent Home Involvement- All parents

The error bar charts (Figure 6-17) show an overlap among the four groups, indicating that the difference in group means of these groups are unlikely to be significant.

Table 6-30 Levene's Test of Equality of Error Variances(a) : Dependent Variable: ChangeHITotal

F	df1	df2	Sig.
1.429	3	200	.235

Levene's Test of the null hypothesis confirms that the error variance of the dependent variable is equal across groups (Table 6-30).

Table 6-31 Tests of Between-Subjects Effects : Dependent Variable: Change Home involvement with preHI as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreHI	1084.330	1	1084.330	106.275	.000	.348
Exptmethod	7.899	3	2.633	.258	.856	.004
Error	2030.416	199	10.203			
Total	3227.000	204				
Corrected Total	3142.877	203				

a R Squared = .354 (Adjusted R Squared = .341)

The ANOVA Table (Table 6-31) showed that the treatment method did not have a significant effect on the change in parental home involvement. Hence, the null hypotheses cannot be rejected.

Table 6-32 Tests of Between-Subjects Effects for Gain parent home involvement with preHI as covariate

Dependent Variable: Gain parent home involvement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreHI	1084.330	1	1084.330	106.275	.000	.348
comm	.150	1	.150	.015	.904	.000
workshop	3.507	1	3.507	.344	.558	.002
comm * workshop	4.909	1	4.909	.481	.489	.002
Error	2030.416	199	10.203			
Total	3227.000	204				
Corrected Total	3142.877	203				

a R Squared = .354 (Adjusted R Squared = .341)

All three conditions, workshop, communication and the combined conditions did not have a significant effect on the change in home involvement (Table 6-32).

Table 6-33 Pairwise Comparisons for Gain parent home involvement with preHI as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	-.579	.662	1.000
	Communication only	-.369	.651	1.000
	Workshop*Communication	-.320	.673	1.000
Workshop	Control	.579	.662	1.000
	Communication only	.210	.602	1.000
	Workshop*Communication	.260	.628	1.000
Communication only	Control	.369	.651	1.000
	Workshop	-.210	.602	1.000
	Workshop*Communication	.049	.618	1.000
Workshop*Communication	Control	.320	.673	1.000
	Workshop	-.260	.628	1.000
	Communication only	-.049	.618	1.000

Based on estimated marginal means Adjustment for multiple comparisons: Bonferroni.

The difference between the group means between the groups were not significant (Table 6-33).

Interaction Effects

The ANOVA Table (Table 6-34) indicates that the main and interaction effects of the two factors are not statistically significant.

Table 6-34 Tests of Between-Subjects Effects for ChangeHITotal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreHI	1084.330	1	1084.330	106.275	.000	.348
Workshop	3.507	1	3.507	.344	.558	.002
Communication	.150	1	.150	.015	.904	.000
Workshop * Communication	4.909	1	4.909	.481	.489	.002
Error	2030.416	199	10.203			
Total	3227.000	204				
Corrected Total	3142.877	203				

Table 6-35 Levene's Test of Equality of Error Variances(a) : Dependent Variable: ChangeHITotal

F	df1	df2	Sig.
1.429	3	200	.235

Levene's Test of the null hypothesis confirms that the error variance of the dependent variable is equal across groups (Table 6-35).

The difference between the group means between the groups were not significant (Table 6-36).

Table 6-36 Pairwise Comparisons for Gain parent home involvement with pre home involvement as covariate

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.(a)
Control	Workshop	-.778	.827	1.000
	Communication only	-.951	.792	1.000
	Workshop*Communication	-.524	.912	1.000
Workshop	Control	.778	.827	1.000
	Communication only	-.173	.744	1.000
	Workshop*Communication	.253	.861	1.000
Communication only	Control	.951	.792	1.000
	Workshop	.173	.744	1.000
	Workshop*Communication	.426	.838	1.000
Workshop*Communication	Control	.524	.912	1.000
	Workshop	-.253	.861	1.000
	Communication only	-.426	.838	1.000

Based on estimated marginal means a Adjustment for multiple comparisons: Bonferroni.

Table 6-37 Gain parent home involvement (without covariate)

Workshop only	Communication only	Mean	Std. Deviation	N
no Workshop	No Communication	.20	4.27	41
	Communication	1.02	4.74	59
	Total	.68	4.55	100
Workshop	no Communication	.93	3.11	54
	Communication	.26	3.42	50
	Total	.61	3.26	104
Total	no Communication	.61	3.65	95
	Communication	.67	4.18	109
	Total	.64	3.93	204

From the profile plots in Fig 6-18, an interaction effect was present between the workshop and communication conditions. Parents in the communication group showed a higher increase in gain in home involvement (M =1.02, SD = 4.74). Parents in the workshop group (without communication) fared better (M= .93, SD =3.11) (Table 6-37). Perhaps parents' home involvement was enhanced as they became more motivated to be involved at home by what they learned during the workshops.

Parents who received both the newsletters and who attended the workshops could have either been overwhelmed or confused by the amount of information, and the implicit expectations conveyed through the newsletters as to how they could support their children learning at home, which inadvertently resulted in an overall lower home involvement. It is also noted that the smaller gain scores in Home Involvement could have been due to a high pre test score.

However, it is also noted that the combined effect was not found to be statistically significant and the outcome could have happened by chance.

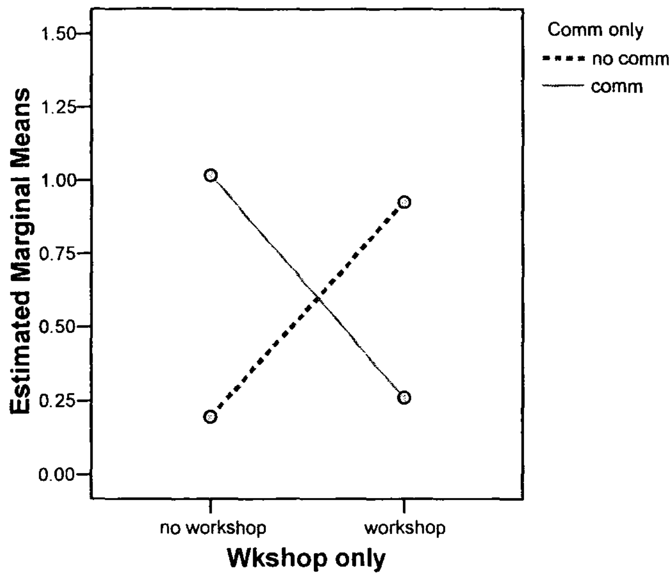


Figure 6-18 Means Plots of Gain in Home Involvement (without covariate)

Parents with Primary & Secondary Education

The error bar charts (Figure 6-19) show an overlap among the four groups, indicating that the difference in group means of these groups are unlikely to be significant.

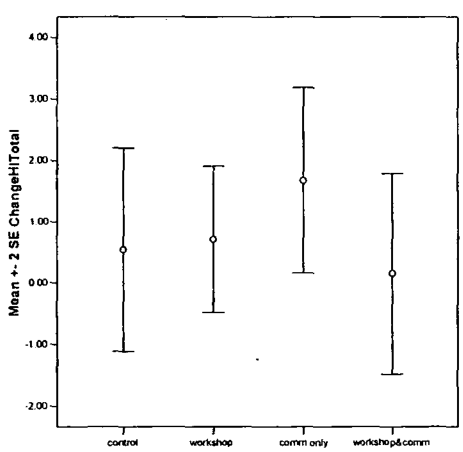


Figure 6-19 Error Mean Graph for Gain in parent Home Involvement

The group mean for change in home involvement was highest in the communication only group (M=1.68, SD=4.41), and very small positive gains were seen in the other three groups (Table 6-38).

Table 6-38 Groups Means for Gain in Home Involvement with preHI as covariate

Method	Mean	Std. Deviation	N
Control	.55	3.89	22
Workshop	.71	3.16	28
Communication only	1.68	4.41	34
Workshop*Communication	.16	3.56	19
Total	.89	3.82	103

Table 6-39 Levene's Test of Equality of Error Variances(a) :Dependent Variable: ChangeHITotal

F	df1	df2	Sig.
.075	3	99	.973

Levene's Test of the null hypothesis confirms that the error variance of the dependent variable is equal across groups (Table 6-39).

Table 6-40 Tests of Between-Subjects Effects Gain in Home Involvement with pre Home involvement as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TotpreHI	636.50	1	636.50	76.01	.000	.437
Exptmethod	13.05	3	4.35	.52	.670	.016
Error	820.63	98	8.37			
Total	1574.00	103				
Corrected Total	1491.83	102				

a R Squared = .450 (Adjusted R Squared = .427)

The ANOVA Table (Table 6-40) showed that the treatment method did not have a significant effect on home involvement.

Time spent on Homework

A cross tabulation of reported time spent on homework (Post) and by parent education level was run to see if there was any significant association between these two variables.

Table 6-41 Method * time spent on homework (POST) by parent education Crosstabulation - Count

Parent Education level			time spent on homework(POST)		Total
			0-30 minutes	30-60 minutes	
Primary/ secondary	Method	Control	8	11	19
		Workshop	5	8	13
		Communication only	22	12	34
		Workshop*Communication	10	9	19
	Total		45	40	85
Tertiary	Method	Control	4	9	13
		Workshop	13	10	23
		Communication only	18	6	24
		Workshop*Communication	21	10	31
	Total		56	35	91

Table 6-42 Chi-Square Tests

Parent Education level		Value	df	Asymp. Sig. (2-sided)
Primary/secondary	Pearson Chi-Square	5.151(a)	6	.525
	Likelihood Ratio	6.281	6	.392
	Linear-by-Linear Association	1.752	1	.186
	N of Valid Cases	85		
Tertiary	Pearson Chi-Square	8.226(b)	6	.222
	Likelihood Ratio	8.580	6	.199
	Linear-by-Linear Association	5.115	1	.024
	N of Valid Cases	91		

a 4 cells (33.3%) have expected count less than 5. The minimum expected count is .76.

b 4 cells (33.3%) have expected count less than 5. The minimum expected count is .57.

No significant association between the treatment and the time spent on homework was found across four experimental groups (Table 6-42).

Summary of Findings and Interpretations :

Results of the Factor Analysis of the parent involvement instrument

Factor analysis using the principal component Promax method classified the 34 indicators into 5 clusters. Of these five clusters, three were selected as dependent parent variables : Parent Confidence (efficacy), Parent Encouragement and Home Involvement. Group means of the change score (post – pre) of these three variables were compared.

The key findings in relation to the parent dependent variables are summarized in Table 6-43.

Parent Confidence / Efficacy

Gain in parent confidence was seen in all groups (all parents). The changeConf was highest in the workshop group, followed by the communication and workshop*communication groups.

For both sets of ANOVA analyses run for all parents and parents with primary/secondary education (n = 102), the experimental condition did not have a significant effect on this variable.

Pairwise comparisons of differences between groups with and without workshop and communication conditions showed that these were not statistically significant. Hence, both null hypotheses $H_0 : \mu_{\text{No Communication}} = \mu_{\text{communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$ could not be rejected. The main effects of workshop and communication were not significant.

The means plots showed an interaction effect between the workshop and communication condition. However, the interaction effect was not statistically significant (p>.05). Hence, the hull hypothesis $H_0 : \mu_{No\ Workshop*Communication} = \mu_{Workshop*Communication}$ could not be rejected (Table 6-13).

The effect sizes for gain scores in parent confidence for all three experimental groups (all parents) compared to the control group were small. Effect sizes for parents with tertiary education in the workshop and communication group (0.43) were higher than the effect sizes of those found in the same groups for parents with primary/secondary education.

Parents in the workshop group showed a higher increase in parent confidence. The communication condition appeared to have lowered the effect of the workshop condition instead of enhancing it. This finding is a puzzling one because the expected largest gain in parent efficacy would be in the workshop*communication group, which was the case for the children's math gain scores. A probable reason for this unexpected result could be that the information in the newsletters was deemed as being less helpful as compared to the workshops itself and may have resulted in some confusion among parents who had also attended the parent education workshops. There is also a possibility that there were some parents who may have preferred a translated version of the newsletters as opposed to an English version, which could explain why the information found in the newsletters were not considered to be helpful. Compared to parents who did not receive the newsletters, the effect of the workshop was more prominent, which resulted in higher gains in parent confidence.

Besides the above analysis, observations from the teachers' perspectives (e.g. Teacher M from the workshop group[41]) recorded that the children in the class were excited about the math kits and that some parents were asking for more games during the weekends.

Teacher A from the workshop*communication group observed that the parents in her group were actively guiding their children to problem solve during the parent workshops on the math activities (e.g. Number line and number bonds). Parents in these groups also shared with the teachers how their children looked forward to getting a new math kit because of the positive experience they had with the earlier math kits, which had materials that were 'very concrete' which made learning math enjoyable for the child.

Furthermore, parents expressed interest in finding out how mathematical concepts are taught in class so that they could reinforce the concepts with their child at home in a similar way. Responses from parents on the evaluation forms showed that 83% agreed that they felt more confident in helping their child after attending the workshops[42]. 88% of parents agreed that the workshops have enabled them to learn how to make use of materials at home to help their child learn. Teachers also noted that they played an active role in explaining and helping parents understand how to use the math kits to facilitate their child's learning of math at home. These observations lend support to how workshops can contribute in more practical and helpful ways in helping parents to become more confident and involved at home with their children's learning, as compared to newsletters. Newsletters, in comparison with workshops, lacked the elements of

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[41] For supporting analysis, please see Chapter 4, pp. 127

[42] For the supporting evidence, please refer to Table 4-1 in chapter 4, pp.111

modeling and demonstration which are essential for helping parents to learn and adapt their own understanding and beliefs about how to help their children learn math.

Parent Encouragement

The gain score for encouragement was highest in the workshop group followed by the workshop*communication group. Negative gains scores were seen in the control and communication groups.

For both sets of ANOVA analyses run for all parents and parents with primary/secondary education (n = 102), the experimental condition did not have a significant effect on this variable ($p>.05$). However, the difference between the workshop and no workshop groups was statistically significant ($p<.05$) : $F(3,200)= 4.66$; $p<.05$. Partial eta squared = .032 (medium effect) (Table 6-23). Hence, the null hypothesis: $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$ was rejected, indicating that the workshop condition had a greater effect than the communication condition on gain in parent encouragement.

Since the group means for the communication and No communication conditions were not statistically significant, the null hypothesis for communication i.e. $H_0 : \mu_{\text{No Communication}} = \mu_{\text{communication}}$ could not be rejected. From the means plots, there did not appear to be any interaction effect.

Table 6-43 Summary of Quantitative Findings for parent dependent variables

Dependent variable (post-pre)	Levels	Positive gain score – starting with Highest	Negative gain score	Significance		Effect Size in treatment groups
Gain Parent Confidence	All parents	1. Workshop 2. Communication 3. Workshop*Communication 4. Control	Nil	Not significant for main and interaction	Interaction present, but not significant	Small positive effect size in Workshop, Communication and Workshop*Communication Groups (all children)
	Primary/ Secondary	1. Workshop 2. Control 3. Communication 4. Workshop*Communication	Nil	Not significant	--	
Gain Parent Encouragement	All parents	1. Workshop 2. Workshop*Communication	1. Control 2. Communication	Significant for Workshop effect	--	Small positive effect size in Workshop, very small effect size for Communication and Workshop*Communication Groups (all children)
	Primary /Secondary	1. Workshop 2. Workshop*Communication	1. Communication 2. Control	Not significant	--	
Gain Parent Home Involvement	All parents	1. Workshop*Communication 2. Communication 3. Workshop	Control	Not significant	--	• Small positive effect size in Workshop, Communication and Workshop*Communication Groups (all children) • Medium positive effect size for children of tertiary educated parents (0.63)
	Primary Secondary	1. Communication 2. Workshop 3. Control 4. Workshop*Communication	Nil	Not significant	Interaction present, but not significant	

Parent Home Involvement

Gain scores were seen in all three treatment groups, except the control group, which had a negative gain score. However, among parents with primary/secondary education, the largest increase in home involvement was found in the communication only condition. For the tertiary educated parents, gain in home involvement was positive only for the Workshop group and negative in all the other experimental groups. The means plots indicate that there was an interaction effect between the two factors.

Although there was an interaction effect, this effect, together with the experimental method as well as the main effects for both the workshop and communication conditions were not statistically significant. Hence, the following null hypotheses cannot be rejected since there were no significant differences between the group means : $H_0 : \mu_{\text{No Communication}} = \mu_{\text{communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$ and $H_0 : \mu_{\text{No Workshop\& Communication}} = \mu_{\text{Workshop*Communication}}$

In terms of effect size, the highest gain in home involvement was observed in the workshop group among the tertiary educated parents (ES = 0.63, medium size), which was noticeably higher than the effect sizes in the communication (0.37) and workshop*Communication (0.39) Groups which were small.

Parents' feedback from those who attended the parent workshops indicated that the workshops had a positive impact on their own role construction. For example, a parent commented that she :

> "learned how to encourage and help my child in her math, e.g. How to make use of materials at home – like using beads to teach math and simple toys to relate with numbers."

The next chapter will address the findings of this study in respect to the original research questions and hypotheses as well as interpret the implications of the study.

Conclusion

Despite the lack of statistically significant results found in the differences in group means between the treatment and control group for the three parent variables, feedback from parents expressed in the evaluation forms revealed other effects of the interventions which could not be captured in the survey instrument. For instance, it was noteworthy that the qualitative evaluations given by parents indicated improvements in their sense of efficacy in helping their children learn math at home. For instance, a parent who attended the workshop commented that,

> "throughout the workshops, I've learnt useful tips about everything on math, making it very interesting through play, and it has enabled me to teach my child confidently. I thought I was going to be hopeless to teach my child math, but this workshop really gave me a change of math teaching concept through play and illustrations."

Parents also discovered many different ways and learned to make use of materials like beads, to teach math and the correct math language to use to introduce math concepts to their children[43].

Feedback from parents in the workshop group showed a qualitative shift in their approach to teaching their child learn math at home. Many parents shared that learning through real life problems and the use of physical objects

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[43] Please see pp. 117 (2b, 2f, 3b) for evidence.

like beans, playing cards and drawings have helped their child develop a clearer picture and understanding of mathematical concepts.

The workshop also gave parents "the skills and techniques to handle math effectively" and allowed both "parent and child to get involved in the activities at the same time, allowing the parent to 'gauge his (child) learning abilities'. Some parents described specific knowledge and skills that they gained from attending the workshops which included the use of the number line to help teach their children 'more' and 'less'. Number bonds using objects like beads was a useful concept that they learned to teach addition and subtraction. The math kits were also deemed as a good starter for some parents who took the ideas and expanded on them at home. Through the math kits and materials provided, parents were able to apply what they learned during the workshops in teaching their child to learn math at home.

Comparing the feedback from the communication group and the workshop groups, there was significantly less feedback from the former group in terms of the type of skills and knowledge that they could apply directly to their own situation.

The feedback from the communication group in terms of how they responded to the ideas that were shared in the newsletters, were qualitatively different from the workshop group. The workshop group expressed a greater sense of awareness and learning, and were more engaged in using the math kits at home with the children, as a result of the workshops. The communication group continued to request for more worksheets for their children to practise at home as compared to the workshop groups that requested more math games and resources other than assessment and worksheets for their children. The latter group of parents acknowledged that they had gained a greater awareness and confidence in using everyday materials and activities to help children learn math at home after attending the workshops, as compared to parents in the communication group. Further discussion on the findings will be presented in the next chapter.

7. Discussion and Conclusion

This chapter aims to summarise the key findings of the study and will provide some plausible explanations of the results in relation to the research questions and hypotheses. Firstly, it will discuss the findings in terms of the different treatment conditions (workshop, communication and workshop*communication) on the following: children's math achievement, parent confidence, parent encouragement and parent home involvement. Reference to the relevant literature will be made to compare the findings of this study in relation to other studies done and the contributions this study has made to the field of knowledge related to parent involvement.

The main strengths and limitations of the study will also be presented, followed by a discussion on the implications for educational practice and recommendations for further research based on the results of the study.

Participants in the treatment groups were expected to perform better than those in the control group. The research hypotheses were as follows :

1. Greater improvement in math achievement (for children) and gains in parent confidence, encouragement and home involvement for the treatment groups as compared to the control group.
2. The largest gains in math achievement, parent confidence, encouragement and home involvement would be seen in the workshop*communication group compared to the other two experimental treatments and control group.

Children's Math Achievement Outcome

Research Question 1 : Does a single type of school initiated involvement (Parent education workshop or communication) or a combination of types of school initiated Involvement (Parent education workshop with communication) help to improve children's math outcomes ?

This study reported that children's math gain score was largest in the workshop*communication (M=4.89, SD = 6.17, Table 5-18, p.169) group for all children. Children in the Band 1 group (lower pre test math scores) also performed better (M=10.84, SD= 6.71, Table 5-24, p.174) compared to the other three groups. Effect size for math score in the workshop*communication group (Band 1) was found to be moderate positive (0.54). Findings of this study show that the workshop*communication condition had a statistically significant effect on children's math achievement, particularly among those with lower pre-test math score.

The interaction effect of the workshop*communication conditions was statistically significant. Better improvement in children's math scores was seen in the group with both workshop and communication conditions than the group with workshop only and communication only condition. This finding supports the hypothesis that the largest gains in math achievement would be seen in the workshop*communication group compared to the other two treatment and control groups.

Although gains in math were seen in the workshop and communication groups, these were not significant, Hence, the null hypotheses $H_0 : \mu_{\text{No communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{Workshop}}$ for these two conditions could not be rejected.

communication through newsletter alone did not result in improvements in children's math achievement. This perhaps can be explained by the limited impact which one-way communication such as newsletters has on shaping parental beliefs and confidence, as these lacked the direct and hands-on learning and interactions that the workshops could offer. Without the opportunity for teachers to share, explain and demonstrate the hands-on way of teaching math to young children using everyday materials, games and activities, parents in the communication group were not exposed to the teaching methodology of how to help young children develop math concepts, expressed much less feedback in relation to the development of their own understanding of how they can help their children learn math. As pointed out in Chapter 4, the evaluation given by parents in the communication group seemed to show a different level of awareness and understanding of ways to help children learn math at home.[44]

Findings in the workshop*communication group concur with studies that have found that preschool programmes that train parents to work with their children at home tend to have significant, positive effects (Baker et al., 1998, Kagitcibasi et al. 2001, Mathematica, 2001, Starkey and Klein, 2000). Children from all family backgrounds and income levels made gains (Henderson & Mapp, 2002, Sylva et al., 2004).

Findings of this study also concur with Shaver and Walls' study (1998) which found that workshops for parents informing them about what their children were learning and how to help their children at home were connected to gains in children's reading and math achievement. The workshops for the parents included updates on their children's progress,

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[44] Please see, for the analysis, chapter 4, pp. 125

training on topics relating to parents' interests (e.g. increasing your child's vocabulary etc) and learning packets in reading and math, as well as training in how to use them.

One explanation for this finding is that parents need more information about how to help children and teachers need to be more explicit and practical in their suggestions for parent involvement through modelling. The two-way communication which was present in the workshop sessions for parents, as opposed to only one-way communication e.g. newsletters, allowed teachers to ask parents what they were doing at home to help their children academically and reinforce parents' interest in helping their child. Although newsletters can provide information about topics that are covered in class and share information about how parents can help children master material, practice skills, this by itself cannot replace the explicit demonstration and modelling strategies on how to help with homework. (Drummond and Stipek, 2004). Moreover, at 6 years of age, children's mental operations are still at the pre-operational stage and their learning is best supported with the help of concrete materials to develop a grasp of some abstract math concepts such as number bonds, addition and subtraction. Hence, math games and materials when sent home coupled with some parent training, can equip parents to facilitate a more age appropriate home learning environment.

Parent Dependent variables

Parent Confidence – Efficacy and Ability to Help Children Learn at Home

Research Question 2: Does a single type (parent education workshop or communication) of school initiated involvement or a combination of types of school initiated Involvement (workshop with communication) help to improve Parent self efficacy and confidence in helping their child's mathematics learning at home ?

The largest gain in parent confidence was found in the workshop group (M=3.72, SD=9.2) (Table 6-9, p. 222), followed by the communication and workshop*communication groups. However, these were not statistically different.

An interaction effect on parent confidence was observed between the two conditions, workshop*communication. In this instance, the communication condition appeared to have lowered the effect of the workshop condition as opposed to enhancing it. However, this together with the main effects for workshop and communication, were not statistically significant. Hence, the null hypotheses for the treatment conditions could not be rejected as the group differences compared to those of the control group were not significant.

This finding is a puzzling one as the expected largest gain in parent efficacy would be in the workshop*communication group, since the largest math gains was also found in the workshop*communication group. A probable reason for this unexpected result could be that the information in the newsletters was deemed to be less helpful as compared to the workshops as these could have resulted in some confusion among parents who had attended the parent education workshops. There is a possibility that there were some parents who may have preferred a translated version of the newsletters as opposed to an English version. This could explain why the information found in the newsletters were not considered to be helpful. As compared to parents who did not receive the newsletters, the effect of the workshop was more prominent, which resulted in higher gains in parent confidence. Other possible reasons for the lack of statistical significance for the workshop*communication condition is presented on pp. 275-277 of this chapter.

Among the treatment groups, the gain in confidence was largest for parents with primary/ secondary education (M=5.19, SD=11.35). (Table 6-15, p.227) Feedback from parents who attended the parent education workshops, indicated that they have benefited from the sessions in terms of their knowledge and understanding in relation to how to support their children in learning math at home, as presented in Chapter 4. Parents who attended the workshops highlighted and mentioned the usefulness of these workshops in helping them learn new knowledge and skills about the children's math curriculum and what would be taught in the primary school. Parents expressed that the workshops together with the math kits had helped to give them a better understanding and confidence in helping their children learn math concepts in a fun and meaningful way.

As the family math workshops required parents to attend with their children, parents were able to be actively involved in the child's activities and learned how to extend opportunities for learning into the home. Teachers provided parent with vicarious experiences using social modelling through the math games and activities that were planned and conducted during the workshops. Hence, parental development of knowledge about teaching math was supported by these opportunities to learn, participate in and practise the strategies used by the teacher to promote and enhance the child's math learning experience at home.

The above factors are, in principle, modifiable by educational processes i.e. by the process of learning and teaching (Hoover-Dempsey and Sandler 1997). This together with the written feedback from parents who attended the workshops provide evidence that parents' involvement at home have improved in terms of their knowledge and skills learned and how they were able to apply these towards helping their children's learning in math through the math kits. Children's gain in math score were also found among parents with primary/secondary education in the workshop*communication group as well. Findings in this study show some similarity with the study by Sylva et al in their study on EPPE (Effective Provision of Pre-school Education Project) which found that the home learning environment (HLE) which included playing with numbers and shapes, reading, teaching through play[45] etc was only moderately associated with parents' educational level. In other words, what parents do with their children is more important than who the parents are. The authors concluded that mothers with few qualifications can improve their children's progress and give them a better start at school by engaging in activities at home that engage and stretch the child's mind.

As suggested in Chapter 2, (see Figure 2-2), parent confidence or self efficacy can be increased through parent education workshops, which can help parents to acquire new knowledge and skills on how to help their child learn at home. This in turn can influence the way parents encourage and become involved in their children's learning at home through direct instruction. A key determinant of parental involvement is their sense of personal efficacy which has to do with whether parents believe and are confident about their ability to be helpful to their child. Important factors that shape parents' sense of efficacy depend on whether they :

- Have the skills and knowledge necessary to help their children
- Their children can learn from what they have to share and teach
- They can find alternative sources of skill or knowledge which are necessary to shape their sense of efficacy

[45] This is similar to the math kits that were used by parents in this study

According to Bandura (1995) there are four types of influence that develop people's general beliefs concerning their efficacy: mastery of experiences, vicarious experiences, social persuasion and physiological and emotional states. This study incorporated the first three types of strategies to promote parental self-efficacy.

Parents in the experimental groups with the workshop condition were given direct assistance, support and materials that they could use at home to facilitate their children's learning of math concepts. The math kits together with the workshops provided parents the knowledge and guidance on how to use everyday materials to support children's understanding of math concepts and enabled them to talk about number concepts such as counting on, addition and subtraction, number bonds, patterning, simple word sums etc with their children.

This study shares similar findings with Drummond and Stipek's (2004) study which suggested that parents may be particularly responsive to teacher suggestions. Parents in this study shared that they had benefited in terms of learning new ways of helping their child learn math at home and were also actively engaged in helping their children with the math activities through the math kits provided. [46] In Chapter 4, Teacher A [47] related how she helped a parent by sharing more information on how to make use of the math kits to reinforce the concept at home after she observed him facilitating his child with a number line activity.

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[46] Refer to Chapter 4, pp. 117, point 2f

[47] Please refer to Chapter 4, pp.128-129 for the supporting evidence

The origins of self-efficacy beliefs are drawn from four general sources (Bandura, 1986). The most powerful is *direct experience* of a positive and successful nature in the field or domain of interest. With reference to the sense of efficacy for helping children succeed in school, this source suggests that parents who have had prior personal experiences of successfully helping children succeed in school would be more likely to have higher efficacy for helping children succeed in school. (Hoover-Dempsey and Sandler, 1995).

The second source of personal efficacy beliefs is *vicarious experiences*. Parents who have observed (or been told of) successful involvement activities and experiences by others – especially those who are significant and similar to themselves – will be higher in efficacy for helping children succeed in school than will parents who have had no or limited opportunities to observe others successfully helping children in school-related activities. Through the workshops, parents had opportunities to interact with teachers and other parents, and by participating in the activities and making use of the math kits at home, they were able to learn 'skills and techniques to handle math effectively, and have learned how to encourage and help my child in her math'[48].

Another source of personal efficacy is *emotional arousal*. Applied to parent efficacy, this suggests that parents who are emotionally and directly concerned about their children's success or whose personal sense of adequacy is emotionally connected to success in helping one's child be successful, will be more likely to be high in efficacy. As shared by a few parents who commented positively about how the workshops have helped

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[48] For supporting analysis, please see chapter 4, p. 116-117 (1e, 2b etc.)

them to "teach math in so many different ways – these new ways certainly help in the teaching of math to my child. Very satisfying to know all these !" and have given them "a better idea on what the P1 mathematics syllabus is like and also how to tackle problems in coaching my children with their work"[49].

Verbal persuasion, another source of efficacy beliefs, where parents who have been told by others who are significant to them, (e.g. teachers or other parents) that their involvement is important, can have a significant positive impact on children's educational success, and also influence the parents' sense of self efficacy.

From the investigator's own observation, most of the teachers who conducted the parent education workshops were able to relate and interact with parents in a friendly way, and were available to help provide parents with advice and guidance as the parents were working with their children on the various math kits and activities. They were able to explain and demonstrate to the parents by showing how to use the math kits and materials to guide the children how to sort, arrange a pattern and group objects to form number bonds.

Parent education workshops and information sessions provide parents with mastery experiences to acquire and implement skills that enhance their child's development. 'Modelling involvement' corresponds to Bandura's notion of vicarious experiences i.e. when parents have the opportunity to observe teachers interacting with their children, they may develop the belief

[49] For supporting analysis, please see chapter 4, p. 116 (1d, 1h)

that they can master the skills for successfully participating in similar activities (Bandura, 1986).

Similarly, Pelletier & Brent (2003) who examined parent factors and teacher strategies to foster parent involvement and efficacy in a preschool intervention programme, reported that the five programme components that fostered parents' confidence were : (a) having the opportunity to work 'one on one' with their child, (b) the environment, (c) teacher support, (d) the curriculum, and (e) parent education. Of the five strategies that teachers generated for fostering parent efficacy, the study reported 'positive feedback' and 'parent education' most frequently.

Programmes that help promote the parent as teacher, can help to provide parents with various opportunities for the acquisition of skills that enhance their efficacy beliefs. Bandura (1986, 1997) argues that mastery experiences are the most influential source of efficacy information. High efficacy beliefs can surmount the effects of disadvantaged family background such as parental education level and SES to promote positive development. Through parent education, parents can provide emotional and social support to the child within the school environment while gaining valuable skills to extend learning into the home.

Parent Role Construction – Encouragement

Research Question 3: Does a single type (parent education workshop or communication) of school initiated involvement or a combination of types of school initiated Involvement (workshop with communication through newsletters) help to improve parent encouragement in children's math learning ?

The highest gain in parent encouragement (across education levels) was observed in the workshop group, followed by the workshop*communication group, with negative gain scores found in the control group and the communication group.

Parents with primary/secondary education in the workshop group had a higher gain score (M =2.14, SD=5.53) (Table 6-25, p.234) compared to those with tertiary level education (M =0.35, SD=4.37) (Table 6-7, p. 212). The main effect of workshop condition (Table 6.22, p.232) on parent encouragement was statistically significant for this group. A negative gain score was seen in the communication group. This finding supported one of the hypotheses that the gains in parent encouragement would be seen in the workshop group. However, the null hypotheses for the communication and workshop*communication conditions could not be rejected.

Newsletters appeared to have had a negative effect on parent encouragement. This is an unexpected finding since it was predicted that information sharing using newsletters could help parents to increase their role construction in encouraging their children with learning math at home. One plausible explanation for this is that parents could not relate to the information in the newsletters and did not find the useful in practical ways that they could immediately use. Furthermore, without any modelling and encouragement and interaction with the teachers, the newsletters alone did not help to motivate or change parents' role perception of themselves in helping their children learn math at home.

These findings suggest that parent encouragement is modifiable by educational processes such as parent education workshops. i.e. parent role construction and motivation to become involved in their children's learning is affected by their experiences of specific suggestions and invitations for involvement from teachers and schools. Positive feedback and modelling from teachers during the parent education workshops could have persuaded parents that their actions have an impact on their child's development, and may encourage parents to try their best and sustain their efforts longer.

Parent Home Involvement

Research Question 4 : Does a single type (parent education workshop or communication) of school initiated involvement or a combination of types of school initiated Involvement (workshop with communication) help to improve parent home involvement in children's math learning?

Small gains in parent home involvement were observed in all groups, with the largest found in the communication group followed by the workshop group. Among parents with Diploma /Tertiary education, the highest gain score was seen in the workshop group (M=1.15, SD=3.09, Table 6-7, p.212). Perhaps parents in this group responded better to the parent education workshops in terms of their becoming involved at home. Although gains in parent home involvement were seen in the workshop and communication groups, these were not significant, Hence, the null hypotheses $H_0 : \mu_{\text{No communication}} = \mu_{\text{Communication}}$ and $H_0 : \mu_{\text{No Workshop}} = \mu_{\text{workshop}}$ for these two conditions could not be rejected.

An interaction effect of the workshop and communication conditions was observed, which was not significant. Parents in the workshop group without the communication condition showed a higher increase in parent home involvement. (M= 3.85 for the workshop only condition and M = 3.13 for the workshop*communication condition). The communication condition appeared to have lowered the effect of the workshop condition on parent home involvement. Since the gain score for the workshop*communication group was the smallest (M=.29), this observation seems to confirm that newsletters do not appear to help increase parent home involvement when combined with the workshop condition. This finding is consistent with the finding reported for the effect of the communication condition on parent encouragement.

In the absence of the workshop condition, gain in parent home involvement was highest in the communication group in particular, for parents with primary /secondary education (M=1.68, SD=4.41) (Table 6-38, p. 243).

Gains in home involvement, was higher for parents with primary/secondary education in the communication group, which perhaps suggests that these parents found the information shared in the newsletters more useful in the areas of awareness of the math curriculum, gaining useful ideas on how they can help their child learn math at home, gaining confidence in helping their child with homework, which in turn prompted them to want to become more involved in their children's learning.

The lack of statistical significance of the treatment conditions on the parent confidence and home involvement could have been due to :

1. The sample size for the different experimental groups in the study was relatively small, which makes it more difficult to attain statistically significant results. In particular, the sample size for the control group was smaller than the three treatment groups, which may have resulted in a smaller range of scores.
2. The instrument used for measuring the parent dependent variables, parent confidence and encouragement could have been inadequate in measuring such a complex and abstract concept. Furthermore, A social desirability bias when parents completed the parent survey instrument for both the pre and post test, which inevitably could have led to high scores in both the pre and post test, which in turn resulted in small gain scores. Since the survey forms required parents to

disclose the names of the children, the lack of anonymity could have affected the responses. Whilst the instrument in itself showed high reliability scores, the results collected from parents itself may not have been truly reflective of the real situation. However, as in many self-administered surveys, there is a likelihood of social desirability bias as some questions may be perceived as loaded with prestige or that respondents could have been too eager to please (Oppenheim, 1992). It is also likely that parents were reluctant to admit that they spent less time or engaged their children less often in learning at home.

3. The interventions or the limited exposure to the interventions may have been inadequate or unsuited for bringing about positive gains in parent confidence and home involvement. Although most parents may have received some parent training (either through the newsletter or the workshops), the reality is that parenting skills and attitudes towards helping their children learn math at home would take time to hone and develop. Hence, with the short duration of intervention, the true effect of the interventions may not have been fully discovered.
4. Whilst the participating parents did receive the same interventions (newsletters and workshops), it was not possible to control other mitigating factors like parents' availability of time, motivation and resourcefulness on an individual basis. For instance, parents who attended the workshops or received the newsletters may not have had time to follow-through with their children at home and since there was no standardization of time spent on math learning at home, the newsletters, workshops and math kits by themselves may not have caused the intended change of increasing parent confidence, encouragement and home involvement. Clearly, these behaviours and actions of becoming more efficacious and encouraging may not have been easily captured by using a self-reporting survey instrument. Instead, these behaviours are complex and demanding to document,

which may require more sophisticated techniques of video recording and interviews.

5. The newsletters which appeared to have reduced the effect of the workshop condition indicate that parents may have found the information provided less useful or even confusing, with regard to helping them improve their sense of efficacy and encouragement and home involvement, as compared to parents who attended the parent education workshops only.

Implications for practice

This study adds to the existing knowledge base by demonstrating that parent education workshops, combined with communication (newsletters) can enhance children's math achievement, particularly for children whose parents are primary/secondary educated. Parent encouragement, and to some extent, parental self efficacy and parent home involvement can also be enhanced by Parent Education Workshops[50].

It would seem that if the parenting involvement practices of most parents could be raised, advances in math achievement might reasonably be expected. This study affirms that parent knowledge and skills are open to influences of teaching and learning, through parent workshops as well as a combination of workshops and newsletters.

The study also suggests that teacher-parent interaction is necessary to afford the transfer of information to help build parental capacity for helping with learning math at home in developmentally appropriate ways. communication using newsletters alone did not help improve parent role

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[50] Supporting evidence is reported in chapter 4, pp. 112, 116-117 and p. 218, Table 6-8

construction of encouragement, home involvement and sense of efficacy. Nearly a third of the feedback from parents on the newsletters were 'neutral' in their response to questions in the evaluation, indicating that they did not find the content helpful or interesting.[51] Instead, supportive interactions in the form of workshops and information given about how to support children's learning through useful materials and resources helped to promote parent confidence and involvement at home[52].

Based on the findings of this study, the following key recommendations for educational practice are :

1. Building parental capacity

As parents will get involved to the degree that they feel they have the capacity to make a difference, they should learn new roles and skills that will help enhance their knowledge and confidence. Hence, it is important that schools provide appropriate opportunities for parental involvement and parent training that are specific to helping children with learning.

Based on the feedback given by parents on the workshops and newsletters, there is empirical evidence that the parents benefited from the specific knowledge and skills they acquired which contributed to increasing their confidence and encouragement of their children's learning at home.

Besides scaffolding children's learning, teachers in this study worked with parents to enhance their understanding and confidence to support children's learning at home by sharing teaching ideas and resources through

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[51] For the supporting evidence, please see Table 4-2 in Chapter 4, pp. 121.

[52] For supporting evidence, please refer to chapter 4 p.117, 2a-2h.

workshops together with newsletters. This form of 'verbal' instruction and demonstration has helped parents develop their sense of efficacy through the acquisition of knowledge and skills. Through parent education workshops, parents were able to observe and model after the teachers in planning and conducting developmentally appropriate math activities.

To be effective, programmes and practices that engage families in home learning should be focused on improving student learning. On the basis of this study, taken together with the results of others' work, the following school initiated activities that can help parents increase their knowledge of how to help their child learn math at home are recommended :

a. Math kits that offer games and learning materials to build skills at home
b. Demonstration activities for parents, and engaging parents to participate and share their experiences during hands-on sessions
c. Interactions with teachers to talk about children's progress and what they are learning, and this should be done in an interactive way where parents get to 'try' and experience what and how the children are taught in the schools so that skills in teaching and facilitating children's interest in learning can be demonstrated and shared with parents
d. Lend materials to each family and advice on how to use them to support children's learning

2. Recognise that all parents of different educational, cultural and income groups, can be involved in their children's learning and want their children to do well in school.

Evidence of the positive effects of workshops on parent encouragement for those with primary/secondary education were found in this study[53], which in the light of social capital theory, can play a part in helping to bridge the class gap, in this case, between the lower and higher educated parents. Therefore, it is important to create programmes that will support families from all socio economic and educational backgrounds to guide their children's learning starting with preschool and through primary school.

For the benefit of families that do not speak or read English, it is important to translate all communications with families into their spoken language and provide an interpreter at meetings and workshops. Information need to be available in the parents' language and teachers can make use of social networks to keep parents informed. More importantly, schools need to establish a welcoming climate and an open-door policy so that any parents who have questions can feel confident about coming to the school for answers (Pena, 2000). The experience gained from conducting this study confirms this aspect as the lower education parents often spoke only Mandarin or Malay and having an interpreter greatly facilitated their participation and sense of belonging and confidence

3. Work with families to build their social connections

Feedback from the parents who attended the workshops commented that they were glad for the opportunity to meet and interact with other parents to exchange ideas and talk about their concerns and resources that they shared in common. Such opportunities are important in helping families to develop their social capital through families' connections with each other, with teachers and other school staff as well as with community groups such

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[53] Please refer to Fig 6-10, chapter 6 p. 219

as libraries, primary schools etc. Hence, schools can work with families to develop their connections with other families and community resources so that they can be better equipped to help their children.

Providing access to curriculum materials and professional guidance from teachers on what to expect in primary schools are especially important and useful for first time parents who have children entering primary school. Feedback from parents also affirms that having become more familiar with the preschool and Primary One Math syllabus[54] has helped them to become mentally prepared, and therefore enable them to adjust their expectations of their children when they transit from preschool to primary school.

4. Develop the capacity of school staff to work with families

An important feature of this study that enabled teachers to be able to plan and conduct the parent workshops was the training and support provided to teachers in planning and preparing the workshop sessions and math kits and activities. Such support in the form of the three training workshops, demonstration sessions on how to use the math kits, and accessibility to consultations and discussions between the investigator and teachers, were integral in helping teachers to build their confidence and motivation to want to work with parents.

From the interactions with the teachers who participated in this study, I have observed that in order for teachers to build collaborative relationships with parents, they need to be given time to plan and organize parent activities. Administrators need to provide teachers with time, resources to plan and work with parents in order to increase parent involvement and participation.

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[54] For supporting evidence, please refer to chapter 4, pp. 116, (1f).

This study suggests that teachers, when given adequate training, preparation and resources, can and are willing to plan and conduct parent workshops that will meet the needs of parents which in turn can benefit the children's learning.

Strengths of the study

In the implementation of the study, all possible measures within the means of the investigator to ensure that the study was conducted according to the original design, and to uphold the validity of the study design, were taken into account :

1. Random assignment of classes to different experiment groups was done to ensure that the groups were probabilistically different i.e. groups differ due to random differences and the independent variable (treatment condition). The samples were also independent in that they were from different classes from different centres.

2. The instruments were piloted and adjusted to suit the local context and groups of parents and children involved in the study. Measures to ensure that the collection of data, which included both quantitative and qualitative data, was confidential and consistently administered, were undertaken. The qualitative data and feedback gathered from parents were also useful in providing a clearer perspective, to see how parents' needs were being met. Qualitative data in the form of parents and teachers feedback using open ended questions in a standard evaluation form were collected to give a better sense of the processes and nuances of parents' and children's participation.
3. By working with intact classes of teachers with the children and their parents, the research design aimed to make use of the realities of the social situations in their natural settings. As ecological validity is an

important aspect of educational research and useful in charting how teaching and parenting practices are actually happening 'at the chalk face' (Brock-Utne, 1996: 617, cited in Cohen, Manion and Morrison, 2000), the study aimed to minimise changing the conditions in which the children, their parents and teachers were familiar with and chose to implement the parent education workshops through the teachers themselves rather than by the investigator herself.

4. The math kits and programme for parent workshops were coordinated to standardise the materials and content

Limitations of study

However, the findings of the study were subjected to some limitations. The lack of statistical significance in some of the differences in group means, resulting in a failure to reject the null hypotheses for the different variables in this study, can be explained by the following limitations of the study. As in any educational research of children and parents, this study was conducted in a real setting which encountered constraints in keeping the non treatment variables constant (e.g. teachers' teaching approaches, parents' own motivation (or lack of) etc). These variables which were free to vary could have created a 'jungle of random error' (Mitchell and Jolley, 2001) that could have hidden the treatment's effect, resulting in a Type 2 error due to :

1. The small sample size in the four treatment groups. This made it difficult to get statistically significant results due to possible random error, which could have amplified the differences between the different groups. This limitation was noted and accepted at the onset of the study as staffing and manpower resources was a genuine constraint, as choosing a larger sample size was deemed not to be a feasible option. The control group also had fewer children due to difficulty in getting more parent participation and faced some attrition

due to changes in staff movements in one of the centres, this may have aggravated the problem of random error caused by the small sample number in this group

2. Duration of treatment. The relatively brief duration of intervention and the lack of a differentiation of the intensity of the treatment condition (e.g. absent, low, high) over a period of not more than 8 weeks may have affected the impact of the programme and the full potential effects of this type of programme intervention may not have been realized.
3. Social desirability bias. As the parent questionnaires were self-administered, the instrument could have had a social desirability bias due to the self-reported response that used a likert scale, as well as the possibility of prestige and goodwill between parents and the teachers. The study mainly addressed parent's beliefs and self reported items and did not directly observe parents' home practices in depth
4. Intervention. The workshops were not completely standardized for the different workshop groups due to the fact that different centres had different teachers with varying teaching experiences and professional qualifications. Although the teachers of the centres were given a standard format of programme outline for the parent workshops to follow and standardized math kits, teachers had a choice in varying the math activities conducted during these workshops. In addition, parents may also not have attended all three workshops. The rationale for allowing this to take place were :
    a. It was deemed more realistic and necessary for teachers to conduct the workshops, as the investigator could not conduct all 3 x 10 sessions by herself due to time constraint and schedules of the parents

b. Empowering the teachers by building their knowledge and skills in developing parent-teacher interactions required that they had some autonomy in planning and implementing the parent workshops
c. Teachers also had better rapport with parents and they played a key role in connecting with parents and children, Hence, they were chosen to be the main facilitators of the workshops as this was important for the success of the workshops

5. Measurement limitations. The criterion-referenced test used for measuring children's math achievement resulted in a ceiling effect on the math scores which was discovered only at an advanced stage of the study. The choice of using a criterion-referenced test as compared to a norm-referenced test was based on practical considerations due to very limited human resource and the tight time frame for the study, Hence, using a norm-referenced assessment would have been too time consuming taking into consideration the sample size of 259 children and the requirement of having to conduct a pre and post test within a short period of time.
6. Poor response from parents for the Focus groups. The focus group interviews originally planned could not be carried out. Only two parents responded but could not make it on the same day. Again, the difficulty in convening focus groups was faced due to limited resource and time factor. However, this setback was compensated in some ways by using the feedback gathered from parents and teachers from the different treatment groups.

Other non treatment variables that could not be fully controlled for during the implementation of the intervention progammes were :

- Differences in the teachers' experiences and teaching approaches, as well as the possibility of social interaction threat, as teachers from one group could have exchanged notes and ideas with one another regarding the programme interventions and materials used,
- Variations in parent attendance of workshops, ranging from 1-3 sessions, since these were not mandatory but voluntary. Due to their busy schedules, not every parent attended all three workshops.
- Variations in the way parents used the math kits. It was not possible to be certain whether parents used the math kits in the same manner or with the same amount of time and appropriateness

Recommendations for Improvements to Study and Further Research

To address these limitations, the following steps and recommendations could be taken to improve the effectiveness and design of the study :

1. Standardize procedures (i.e. the workshop conditions and procedures) and use reliable measures for measuring the parent and child math outcomes. This would also include keeping constant the teachers' experience and qualifications, parents receiving the same amount and type of intervention
2. Use a homogenous group of participants by selecting participants who are similar to one another (e.g. Similar pre-test scores, similar teacher qualifications and teaching experience etc.)

3. Use many participants to reduce random error – increasing the sample size for every group will help to address random error

4. Use different levels of the treatment variable by varying the number of workshop sessions / newsletters (i.e. absent, low, high) for the

treatment groups – this will allow for comparison between the effects of the levels of treatment when varied.

5. Use other reliable measures or indicators for children's math that is not susceptible to a ceiling effect e.g. A norm-referenced test and teachers' documentation of children's interest in learning math concepts through anecdotal observations, with the help of video clips of children's engaging in math activities to further explore and document the key differences observed in children receiving the programme intervention against those who do not receive.

6. Adopt in-depth interviews as a methodology to gather data regarding how parents' self efficacy and parental role construction change over a period of time after receiving the intervention. Again this can be further documented using recordings of parent interviews and /or video clips to allow for a more objective assessment as opposed to subjective self-reporting using self administered questionnaires which are subject to social desirability effect

Conclusions

Since only three out of the 12 null hypotheses set out for this study could be rejected, it is not possible to draw conclusive statements about the effects of the interventions on the various dependent variables that did not have statistically significant results.

Due to the lack of statistical significance in some of the treatment conditions on children's math gain and parent dependent variables, the findings of this study can only be interpreted within the context of the study, where the interventions described and implemented in this study by these teachers, have been tested. Hence, the results of this study cannot be generalized universally, to be the same for all parents and children of the general population.

Within the limitations listed above, this study has nonetheless demonstrated some evidence to support the belief that parental capacity building for involvement comprising parental role definition and parental self-efficacy can be influenced by schools. Schools can serve as active agents to initiate, support and provide opportunities through modelling and sharing of information and resources to help parents develop knowledge, skills and values that will enable them to become effectively involved at home in helping their child learn.

Parental involvement in the form of attending parent education workshops could go a long way in providing parents with a conduit of information (about curriculum, courses, school assessments etc) through which teachers and parents alike can work to support the child.

Given the limited resource and time that schools have, selecting the appropriate type of parent involvement is an important decision and this study has contributed towards helping educators become more aware of the impact of the two types of parent involvement : workshops and newsletters, and therefore being able to make more informed choices.

APPENDIX A : Primary Mathematics Curriculum (Primary 1 to Primary 4)

The objectives of the primary mathematics programme are to enable pupils to:

- develop understanding of mathematical concepts:
    - Numerical
    - Geometrical
    - Statistical
    - Algebraic
- perform operations with:
    - Whole numbers
    - Fractions
    - Decimals
- recognise spatial relationships in two and three dimensions
- recognise patterns and relationships in mathematics
- use mathematical language, symbols and diagrams to represent and communicate mathematical ideas
- present and interpret information in written, graphical, diagrammatic and tabular forms
- use common systems of units
- use geometrical instruments
- perform simple algebraic manipulation
- develop ability to perform mental calculation
- develop ability to perform estimation
- develop ability to check reasonableness of results
- use mathematical concepts learnt to solve problems
- use appropriate heuristics to solve problems
- apply mathematics to everyday life problems
- think logically and derive conclusions deductively
- develop an inquiring mind through investigative activities
- enjoy learning mathematics through a variety of activities

APPENDIX A Continued

PRIMARY 1

TOPICS/OUTCOMES		REMARKS
WHOLE NUMBERS		
1	***NUMBER NOTATION AND PLACE VALUES***	
	Pupils should be able to	
a)	count to 100	a) • Include completing sequences of consecutive numbers • Include counting in tens and completing sequence
b)	read and write numbers up to 100 in numerals and in words	
c)	Recognise the place values of numbers (tens, ones)	
2	***CARDINAL AND ORDINAL NUMBERS***	
d)	give a number to indicate the number of objects in a given set	d) • **Exclude** the term 'cardinal number'
e)	represent a given number by a set of objects	e) • Include visualising small sets up to 5 objects instead of counting one by one
f)	use ordinal numbers such as first, second, up to tenth	f) • Include symbols, e.g. 1st, 2nd, 3rd, etc. • **Exclude** the term 'ordinal number'
3	***COMPARING AND ORDERING***	
g)	compare two or more sets in terms of the difference in number	g) • Include the concept of one-to-one correspondence • Include use of the phrases 'more than', 'less than' and 'fewer than' • Include finding 'How many more/less?'
h)	compare numbers up to 100	h) • Include use of the words: greater, greatest, smaller, smallest • **Exclude** use of the symbols ' > ' and ' < '
i)	arrange numbers in increasing and decreasing order	

APPENDIX A Continued

PRIMARY 1

TOPICS/OUTCOMES		REMARKS
STATISTICS		
1	***PICTURE GRAPHS***	
	Pupils should be able to	
a)	make picture graphs of given data	a) • Include collecting and organising data • Include both horizontal and vertical forms • Include the use of symbolic representations, e.g. ◆ represents one child
b)	read and interpret picture graphs	b) • **Exclude** picture graphs with scales such as each ◆ represents 5 children

TOPICS/OUTCOMES		REMARKS
GEOMETRY		
1	***SHAPES***	
	Pupils should be able to	
a)	Identify and name the following shapes: • rectangle • square • circle • triangle	a) • Include classification of shapes
b)	Identify the following shapes in 3-D objects: • rectangle • square • circle • triangle	
2	***PATTERNS***	
c)	complete patterns according to • shape • size • colour • two of the above attributes	
d)	complete patterns with 3-D solids • cube • rectangular block • cone • cylinder	d) • **Exclude** use of the words 'cube', 'cone', 'cylinder' in written or verbal form

APPENDIX A Continued

PRIMARY 1

TOPICS/OUTCOMES		REMARKS
MONEY AND MEASURES		
1	*MEASUREMENT OF LENGTH AND MASS*	
	Pupils should be able to	
a)	compare the lengths/masses of two or more objects in non-standard units	a) • Include use of simple approximation to measure lengths and masses • **Exclude** finding the difference in length/mass • Include the use of the following words: long, longer, longest short, shorter, shortest tall, taller, tallest high, higher, highest heavy, heavier, heaviest light, lighter, lightest
2	*TIME (12-HOUR CLOCK)*	
b)	tell time in terms of o'clock and half past	b) • **Exclude** use of 24-hour clock
3	*MONEY*	
c)	tell the different denominations of • coins • notes	
d)	match one coin/note of one denomination to an equivalent set of coins/notes of another denomination	
e)	tell the amount of money • in cents (¢) up to $1 • in dollars ($) up to $100	e) • Include use of symbols '$' and '¢' • **Exclude** combinations of dollars and cents
f)	add and subtract money • in dollars only • in cents only	
g)	solve 1-step word problems on addition and subtraction of money • in cents only • in dollars only	g) • Include finding 'How much more/less?'

APPENDIX A Continued

PRIMARY 1

TOPICS/OUTCOMES		REMARKS
MONEY AND MEASURES		
1	*MEASUREMENT OF LENGTH AND MASS*	
	Pupils should be able to	
a)	compare the lengths/masses of two or more objects in non-standard units	a) • Include use of simple approximation to measure lengths and masses • **Exclude** finding the difference in length/mass • Include the use of the following words: long, longer, longest short, shorter, shortest tall, taller, tallest high, higher, highest heavy, heavier, heaviest light, lighter, lightest
2	*TIME (12-HOUR CLOCK)*	
b)	tell time in terms of o'clock and half past	b) • **Exclude** use of 24-hour clock
3	*MONEY*	
c)	tell the different denominations of • coins • notes	
d)	match one coin/note of one denomination to an equivalent set of coins/notes of another denomination	
e)	tell the amount of money • in cents (¢) up to $1 • in dollars ($) up to $100	e) • Include use of symbols '$' and '¢' • **Exclude** combinations of dollars and cents
f)	add and subtract money • in dollars only • in cents only	
g)	solve 1-step word problems on addition and subtraction of money • in cents only • in dollars only	g) • Include finding 'How much more/less?'

APPENDIX B1 : Consent by Authors to Use the Parental Involvement Survey

http://f334.mail.yahoo.com - Re: Use of questionnaire - Microsoft Internet Explorer

Reply Forward Move Print Delete Spam More Actions

Re: Use of questionnaire Standard Header

Kathy Hoover-Dempsey <kathleen.v.hoover-dempsey@vanderbilt.edu> Add Thursday, April 1, 2004 9:24:17 AM

To: Chan LH <lh6868@yahoo.com.sg>

Hi Lin Ho,
Thank you for sending the abstract of your study. Your study looks very interesting and well designed. Your choice of focus for the parent education workshops (math) seems very good. Lee Shumow at University of Northern Illinois has done some very good work on parent involvement with math; I suspect you know about it, but if you don't, it would be good to check out. Very best wishes as you begin your study. I look forward to hearing about your findings!
Kathy

At 12:11 AM 3/11/2004, you wrote:

> Dear Kathy,
> Yes, Darlene has e-mailed me to confirm that it's ok to use /modify the questionnaires /scales posted on your website. Again, many thanks for all your help and support.
>
> I have been doing quite a lot of searching and reading of articles that you've written, and I admire the amount of research and contribution you have made to this field and topic of parent involvement -- i think it's a model that can help many teachers and schools with working with parents in partnership.
>
> Just to share with you an idea of what my study will cover (see attachment).
>
> If you have any suggestions /ideas /resources to share, it will be most helpful. Thanks again for asking and checking.
>
> Best Wishes,
> Lin Ho
>
> Do you Yahoo!?
> Yahoo! Search - Find what you're looking for faster.

Done Internet

APPENDIX B1 CONTINUED

http://f334.mail.yahoo.com - Permission to use questionnaires - Microsoft Internet Explorer

Reply ▾ Forward Move Print Delete Spam More Actions ▾

Permission to use questionnaires
Darlene Whetsel <darlene.whetsel@vanderbilt.edu> Add
To: lh6868@yahoo.com.sg

Standard Header ▾
Wednesday, February 25, 2004 4:44:26 AM

Chan Lin Ho,

Thank you for your interest in our research. On behalf of Kathy Hoover-Dempsey (she says 'hello' and sends her best) and Howard Sandler, you have permission to use and/or modify any of the scales that have been developed. These scales are on our web site: http://www.vanderbilt.edu/Peabody/family-school/.

We ask that you site the following publication in your papers:

Walker, J. M. T., Wilkins, A. S., Dallaire, J. P., Sandler, H. M., & Hoover-Dempsey, K. V. (Invited paper, under review). Parental involvement: Model revision through scale development. Elementary School Journal.

Also, if you use either the Teacher Efficacy scale or the Parent Efficacy scale, please site:

Hoover-Dempsey, K. V., Bassler, O. C., & Brissie, J. S. (1992). Explorations in parent-school relations. Journal of Educational Research, 85 (5), 287-294.

We wish you all the best with your research and encourage you to send us your findings.

Regards,

Darlene Whetsel
Project Coordinator, The Social Context of Parental Involvement,
Department of Psychology and Human Development, Vanderbilt University
E-mail: d.whetsel@vanderbilt.edu
phone: 615.343.4896
fax: 615.343.9494
mail: Peabody College #512
230 Appleton Place,
Nashville, TN 37203-5701

Done Internet

APPENDIX B2 : Parent Survey Instrument (English)

NTUC Childcare

Parent Involvement Project

Parent Questionnaire

For Office Use only SN :______________________________

Please indicate √ how much you AGREE or DISAGREE with each of the following statements. Please think about your child in this current school year in K2 as you consider each statement :

	THE TEACHERS AT THE CENTRE HAVE HELPED ME IN THE FOLLOWING WAYS :	Disagree very strongly	Disagree	Disagree just a little	Agree just a little	Agree	Agree very strongly
1	keep me informed about my child's progress in school.	1	2	3	4	5	6
2	Become more aware of the K2 maths curriculum	1	2	3	4	5	6
3	Given me useful ideas on how I can help my child learn maths at home	1	2	3	4	5	6
4	Helped me become more involved in my child's learning at home	1	2	3	4	5	6
5	Given me confidence in helping with my child's homework	1	2	3	4	5	6

Please indicate √ HOW OFTEN the following have happened SINCE THE BEGINNING OF THIS SCHOOL YEAR in K2 ?

		never	1 or 2 times this year	4 or 5 times this year	once a week	a few times a week	daily
6	My child's teacher asked me or encouraged me to help my child with homework.	1	2	3	4	5	6
7	My child's teacher contacted me (for example, wrote a note, phoned, e-mailed).	1	2	3	4	5	6
8	I communicate with the teacher about my child's performance, progress and needs related to homework	1	2	3	4	5	6
9	I receive information on what my child is learning at the centre	1	2	3	4	5	6

10 Which of the following is most helpful in giving you information on how to help your child learn at home : **Rank THREE choices : 1, 2 3** that you think would be <u>most helpful</u> to you :

___ Face to face communication with teacher
___ Visits to the classroom
___ Newsletters
___ Homework
___ Telephone calls from teachers
___ Notes from teachers
___ Parent workshops
___Websites

APPENDIX B2 CONTINUED

Please indicate √ how much you AGREE or DISAGREE with each of the following statements. Please think about your child in this current school year in K2 as you consider each statement :

		Disagree very strongly	Disagree	Disagree just a little	Agree just a little	Agree	Agree very strongly
11	I have confidence in helping my child learn math	1	2	3	4	5	6
12	I am successful in helping my child learn.	1	2	3	4	5	6
13	I have a good understanding of the K2 maths curriculum	1	2	3	4	5	6
14	I know enough about the subjects of my child's homework to help him or her.	1	2	3	4	5	6
15	I am able to make use of everyday experiences (eg. While at home or at the supermarket etc) to teach my child	1	2	3	4	5	6
16	I know how to explain things to my child about his or her homework.	1	2	3	4	5	6
17	I have enough time and energy to help my child with homework.	1	2	3	4	5	6
18	I have enough time and energy to communicate with my child's teacher.	1	2	3	4	5	6
19	I know how to help my child be ready for Primary One	1	2	3	4	5	6
20	I can make a big difference in helping my child adjust to Primary One	1	2	3	4	5	6
21	I know where to find resources to support my child's learning	1	2	3	4	5	6
22	I know how to use everyday materials to help my child learn	1	2	3	4	5	6

Parents have many different beliefs about their level of responsibility in their children's education. Please respond to the following statements by indicating the degree to which you believe you are responsible for the following.

	PARENTS ARE RESPONSIBLE FOR THE FOLLOWING :	Disagree very strongly	Disagree	Disagree just a little	Agree just a little	Agree	Agree very strongly
23	...make sure my child understands his /her homework	1	2	3	4	5	6
24	...communicate with my child's teacher regularly.	1	2	3	4	5	6
25	...help my child with homework.	1	2	3	4	5	6
26	.....set family rules about doing homework	1	2	3	4	5	6
27	.....explain things to my child about his or her homework.	1	2	3	4	5	6
28	...talk with my child what he /she is learning at the centre.	1	2	3	4	5	6

APPENDIX B2 CONTINUED

Parents and families do many different things when they are involved in their children's education. We would like to know how often you have done the following SINCE THE BEGINNING OF THE SCHOOL YEAR for your child in K2.

	HOW OFTEN do you	never	1 or 2 times this year	4 or 5 times this year	once a week	a few times a week	daily
29	...talk with your child about what he/she learns at the centre.	1	2	3	4	5	6
30	...make sure this child's homework gets done	1	2	3	4	5	6
31	..visit my child's classroom	1	2	3	4	5	6
32	...attend Parent Teacher Conference meetings.	1	2	3	4	5	6
33	...practice spelling, math or other skills with your child.	1	2	3	4	5	6
34	...read with your child.	1	2	3	4	5	6
35	....help your child with math homework	1	2	3	4	5	6
36	...participate in parent workshops	1	2	3	4	5	6

Parents and families do many different things when they help their children with schoolwork. We would like to know **HOW OFTEN** *you and your family* help your child with schoolwork. Please think about your child in this current school year in K2 as you consider each statement.

	We encourgage and help our child to...	Never	Seldom	Sometimes	Often	Very Often	Always
37	... learn new things.	1	2	3	4	5	6
38	...find new ways to do schoolwork when he or she gets stuck.	1	2	3	4	5	6
39	...to stick with his or her homework until he or she finishes it.	1	2	3	4	5	6
40	...make his or her homework fun.	1	2	3	4	5	6
41	...how to find out more about things that interest him or her.	1	2	3	4	5	6
	We show our child we like it when he or she...	Never	Seldom	Sometimes	Often	Very Often	Always
42	...wants to learn new things.	1	2	3	4	5	6
43	...has a positive attitude about doing his or her homework.	1	2	3	4	5	6
44	...keeps working on homework even when he or she doesn't feel like it.	1	2	3	4	5	6

APPENDIX B2 CONTINUED

We understand that the following information may be of a sensitive nature. We ask for this information because it helps us describe the range of families in our total group. Please tick √ the response for each item that best describes you and your family.

Name of Centre : ____________________

Name of parent : ____________________ (name will be kept confidential and reported as a numeric code)

Your e-mail address : ____________________ (optional -for purpose of sending you information and announcements)

Name of child currently attending childcare : ____________________(name will be kept confidential and reported as a numeric code)

	For Office use only
1. Child's Gender: ____ Female ____ Male	1, 2
2. Your Gender: ____ Female ____ Male	1, 2
3. Your age : ____ 20 -29 ____ 30-39	1, 2
____40-49 ____ 50 and above	3, 4
4. Please choose the job that best describes yours (please choose only **one**):	
___ Warehouse, factory worker, construction	1
___ Driver (taxi, truck, bus, delivery)	2
___ Retail sales, clerical, customer service	3
___ Service technician (appliances, computers, cars)	4
___ Administrative	5
___ Social services, public service, related governmental	6
___ Professional, executive	7
___ Unemployed, student	8
___Others : Please describe : ____________	9
5. On an average day or evening, how much time do you and your spouse spend helping your child with homework, reading and writing?	
___ None ___ 1 - 30 minutes	1, 2
___ 30 - 60 minutes ___ more than an hour	3, 4
6. Your level of education (please check highest level completed):	
___ Primary ___ Secondary / ITE	1, 2
___ Diploma /A level ___ Bachelor /Postgraduate degree	3, 4
7. Your spouse's level of education (please check highest level completed):	
___ Primary ___ Secondary / ITE	1, 2
___ Diploma /A level ___ Bachelor /Postgraduate degree	3, 4

	For Office use only
8. Is your child receiving private tuition for maths, english ?	
____ No	1
____ Yes. Plese specify :__________	2
9. What is the main language spoken at home ? Please choose only one :	
_____ English _____ Mandarin	1, 2
_____ Malay _____ Tamil	3, 4
_____ Others. Please specify :________	5
10. Your Race/Ethnicity:	
____ Chinese	1
____ Malay	2
____ Indian	3
____ Eurasian	4
____ Others. Please specify : __________	5
11. Combined household income per month (check one):	
____ less than $3,000	1
____ $3,000 - $8,000	2
____ Above $8,000	3
12. How many children do you have ?	
___ 1	1
___ 2	2
___ 3	3
___ 4 or more	4

THANK YOU!!!

If you would like to be kept informed of the findings of this study, please fill in the following particulars :

Address : ____________________________________

APPENDIX B2 CONTINUED (with Chinese translation)

NTUC Childcare

Parent Involvement Project
Parent Questionnaire
家长调查问卷

For Office Use only SN:________________

Please indicate √ how much you AGREE or DISAGREE with each of the following statements. Please think about your child in this current school year in K2 as you consider each statement :
请根据您的孩子本年度的学习情况，回答以下的问题。在认同的地方打√。

	THE TEACHERS AT THE CENTRE HAVE HELPED ME IN THE FOLLOWING WAYS : 教师的协助 :	Disagree very strongly 非常不赞同	Disagree 不赞同	Disagree just a little 有点不赞同	Agree just a little 有点赞同	Agree 赞同	Agree very strongly 非常赞同
1	keep me informed about my child's progress in school. 让我知道孩子的学习进度。	1	2	3	4	5	6
2	Become more aware of the K2 maths curriculum 让我对幼稚二班的课程更 加了解。	1	2	3	4	5	6
3	Given me useful ideas on how I can help my child learn maths at home 提供意见，让我懂得如何在家进行数学教学。	1	2	3	4	5	6
4	Helped me become more involved in my child's learning at home 让我懂得如何参与孩子的 学习。	1	2	3	4	5	6
5	Given me confidence in helping with my child's homework 增加我协助孩子学习的 信心。	1	2	3	4	5	6

Please indicate √ HOW OFTEN the following have happened SINCE THE BEGINNING OF THIS SCHOOL YEAR in K2 ? 请根据您的孩子本年度的学习情况，回答以下的问题。在认同的地方打√。

	次数 :	never 不曾	1 or 2 times this year 1－2次(一年)	4 or 5 times this year 4－5次(一年)	once a week 一个星期一次	a few times a week 一个星期数次	daily 每天
6	My child's teacher asked me or encouraged me to help my child with homework. 老师鼓励我协助孩子学习	1	2	3	4	5	6
7	My child's teacher contacted me (for example, wrote a note, phoned, e-mailed). 老师和我保持联络。例如	1	2	3	4	5	6
8	I communicate with the teacher about my child's performance, progress and needs related to homework 我向老师了解孩子的学习表 现和进度。	1	2	3	4	5	6
9	I receive information on what my child is learning at the centre 老师向我汇报孩子的学习	1	2	3	4	5	6

Which of the following is most helpful in giving you information on how to help your child learn at home :
10 **Rank THREE choices : 1, 2 3** that you think would be <u>most helpful</u> to you :
以下各项目，您认为哪些能有效地提高您协助孩子学习的能力。请选三项。

____ Face to face communication with teacher 当面与老师沟通
____ Visits to the classroom 参访课室
____ Newsletters 汇报
____ Homework 功课
____ Telephone calls from teachers 电话联络
____ Notes from teachers 联络本
Parent workshops 工作坊
____ Websites 上网

APPENDIX B2 CONTINUED (with Chinese translation)

Please indicate √ how much you AGREE or DISAGREE with each of the following statements. Please think about your child in this current school year in K2 as you consider each statement :
请根据您的孩子本年度的学习情况，回答以下的问题。在认同的地方打√。

		Disagree very strongly 非常不赞同	Disagree 不赞同	Disagree just a little 有点不赞同	Agree just a little 有点赞同	Agree 赞同	Agree very strongly 非常赞同
11	I have confidence in helping my child learn math 我相当有信心协助孩子掌 握数学。	1	2	3	4	5	6
12	I am successful in helping my child learn. 我觉得在协助孩子学习方 面做得相当好。	1	2	3	4	5	6
13	I have a good understanding of the K2 maths curriculum 我相当了解幼稚二班的数 学课程。	1	2	3	4	5	6
14	I know enough about the subjects of my child's homework to help him or her. 我对孩子所学的科目相当 了解，并且帮助他。	1	2	3	4	5	6
15	I am able to make use of everyday experiences (eg. While at home or at the supermarket etc) to teach my child 我懂得如何利用生活经验（如：在家或购物中心）来教导孩子学习。	1	2	3	4	5	6
16	I know how to explain things to my child about his or her homework. 我能通过讲解来帮助孩子 学习。	1	2	3	4	5	6
17	I have enough time and energy to help my child with homework. 我有足够的时间和精力协助孩子学习。	1	2	3	4	5	6
18	I have enough time and energy to communicate with my child's teacher. 我有足够的时间和精力与老师沟通。	1	2	3	4	5	6
19	I know how to help my child be ready for Primary One 我懂得如何为孩子做好上小一的准备。	1	2	3	4	5	6
20	I can make a big difference in helping my child adjust to Primary One 我能改变自己来协助孩子上小一	1	2	3	4	5	6
21	I know where to find resources to support my child's learning 我知道从何处取得资料来协助孩子学习	1	2	3	4	5	6
22	I know how to use everyday materials to help my child learn 我懂得利用生活资源来帮 助孩子学习。	1	2	3	4	5	6

APPENDIX B2 CONTINUED (with Chinese translation)

Parents have many different beliefs about their level of responsibility in their children's education. Please respond to the following statements by indicating the degree to which you believe you are responsible for the following. 您对家长协助孩子学习有何看法？请回答以下的问题。

	PARENTS ARE RESPONSIBLE FOR THE FOLLOWING：家长应负的责任：	Disagree very strongly 非常不赞同	Disagree 不赞同	Disagree just a little 有点不赞同	Agree just a little 有点赞同	Agree 赞同	Agree very strongly 非常赞同
23	...make sure my child understands his /her homework 确定孩子完全理解功课	1	2	3	4	5	6
24	...communicate with my child's teacher regularly. 时时和老师保持联系	1	2	3	4	5	6
25	...help my child with homework. 协助孩子学习	1	2	3	4	5	6
26	.....set family rules about doing homework 给孩子制订做功课的规 则。	1	2	3	4	5	6
27	.....explain things to my child about his or her homework. 给孩子讲解功课	1	2	3	4	5	6
28	...talk with my child what he /she is learning at the centre. 与孩子交流，了解他在 校的学习情况	1	2	3	4	5	6

Parents and families do many different things when they are involved in their children's education. We would like to know how often you have done the following SINCE THE BEGINNING OF THE SCHOOL YEAR for your child in K2.
在孩子的教育方面，家人扮演着重要的角色。请根据您的孩子本年度的学习情况，回答以下的问题。

	HOW OFTEN do you 次数：	never 不曾	1 or 2 times this year 1－2 次(一年)	4 or 5 times this year 4－5 次(一年)	once a week 一个星期一次	a few times a week 一个星期数次	daily 每天
29	...talk with your child about what he/she learns at the centre. 跟孩子沟通，了解他在 校的学习情况	1	2	3	4	5	6
30	...make sure this child's homework gets done 确定孩子已经完成功课	1	2	3	4	5	6
31	..visit my child's classroom 参访孩子的课室	1	2	3	4	5	6
32	...attend Parent Teacher Conference meetings. 出席家长会	1	2	3	4	5	6
33	...practice spelling, math or other skills with your child. 给孩子听写、数学或其他 技能的练习	1	2	3	4	5	6
34	...read with your child. 陪孩子阅读	1	2	3	4	5	6
35	....help your child with math homework 协助孩子做数学练习	1	2	3	4	5	6
36	..participate in parent workshops 参与家长工作坊	1	2	3	4	5	6

APPENDIX B2 CONTINUED (with Chinese translation)

Parents and families do many different things when they help their children with schoolwork. We would like to know **HOW OFTEN** *you and your family* help your child with schoolwork. Please think about your child in this current school year in K2 as you consider each statement. 在孩子的学习方面，家人扮演着重要的角色。请根据您的孩子本年度的学习情况，回答以下的问题

	We encourgage and help our child to…我鼓励和协助孩子：	Never 不曾	Seldom 很少	Sometimes 有时	Often 时时	Very Often 经常	Always 频密
37	… learn new things. 学习新事物	1	2	3	4	5	6
38	…find new ways to do schoolwork when he or she gets stuck. 寻找不同的解决问题方 法	1	2	3	4	5	6
39	…to stick with his or her homework until he or she finishes it. 陪着孩子，直到他完成 功课。	1	2	3	4	5	6
40	…make his or her homework fun. 让孩子的学习更有乐趣	1	2	3	4	5	6
41	…how to find out more about things that interest him or her. 寻找更多孩子感兴趣的 事物	1	2	3	4	5	6
	We show our child <u>we like it</u> when he or she… 我们表现出很欢喜，当孩子：	Never 不曾	Seldom 很少	Sometimes 有时	Often 时时	Very Often 经常	Always 频密
42	…wants to learn new things. 对学习产生兴趣	1	2	3	4	5	6
43	…has a positive attitude about doing his or her homework. 积极对待功课	1	2	3	4	5	6
44	…keeps working on homework even when he or she doesn't feel like it. 完成他不喜欢的功课	1	2	3	4	5	6

APPENDIX B2 CONTINUED (with Chinese translation)

We understand that the following information may be of a sensitive nature. We ask for this information because it helps us describe the range of families in our total group. Please tick √ the response for each item that best describes you and your family.
我们了解以下的资料可能会有些敏感。收集这些资料的目的是帮助我们了解整体的家庭情况幅度。请在您认为最贴切的选择旁打 √。

Name of Centre 中心名称：: ____________________

Name of parent 家长姓名：____________________ (name will be kept confidential and reported as a numeric code)
（将保密并以数字表示）

Your e-mail address 网址: ____________________ (optional -for purpose of sending you information and announcements)
（非强制性－方便给予资料和通知）

Name of child currently attending childcare 孩子姓名：____________________(name will be kept confidential and reported as a numeric code)（将保密并以数字表示）

	For Office use only
1. Child's Gender 孩子性别: ___ Female 女 ___ Male 男	1, 2
2. Your Gender 家长性别: ___ Female 女 ___ Male 男	1, 2
3. Your age 家长年龄：___ 20 -29 ___ 30-39	1, 2
___ 40-49 ___ 50 and abov	3, 4
4. Please choose the job that best describes yours (please choose only **one**) 您的工作（选择其中一项）:	
___ Warehouse, factory worker, construction 货仓员工，工厂员工，建筑员工	1
___ Driver (taxi, truck, bus, delivery) 司机（的士，货柜车，巴士，递送服务	2
___ Retail sales, clerical, customer service 零售，文书，服务	3
___ Service technician (appliances, computers, cars) 技术业（机械，电脑，汽车）	4
___ Administrative 行政人员	5
___ Social services, public service, related governmental 社会福利，与政府机构相关的行业	6
___ Professional, executive 专业人士	7
___ Unemployed, student 无业－学生	8
___ Others : Please describe 其他：请注明：: ___	9
5. On an average day or evening, how much time do you and your spouse spend helping your child with homework, reading and writing ? 在周日的晚上，您和您的伴侣花多少时间陪孩子学习？	
___ None 没有 ___ 1 - 30 minutes 分钟	1, 2
___ 30 - 60 minutes 分钟 ___ more than an hour 超过一个小时	3, 4
6. Your level of education 您的教育水平。 (please check highest level completed)（以最高程度为标准	
___ Primary 小学 ___ Secondary / ITE 中学/技术学校	1, 2
___ Diploma /A level 证书/A水准 ___ Bachelor /Postgraduate degree 学士/学位	3, 4
7. Your spouse's level of education 您的伴侣的教育水平。 (please check highest level completed)（以最高程度为标准）:	
___ Primary 小学 ___ Secondary / ITE 中学/技术学校	1, 2
___ Diploma /A level 证书/A水准 ___ Bachelor /Postgraduate degree 学士/学位	3, 4

	For Office use only
8. Is your child receiving private tuition for maths, english ? 证书/A水准	
___ No 没有	1
___ Yes. Plese specify 有，请注明：___	2
9. What is the main language spoken at home ? Please choose only one 家里的主要沟通语言是哪一种？请选一项。:	
___ English 英语 ___ Mandarin 华语	1, 2
___ Malay 马来语 ___ Tamil 印度语	3, 4
___ Others. Please specify 其他，请注明：___	5
10. Your Race/Ethnicity 您的种族:	
___ Chinese 华人	1
___ Malay 马来人	2
___ Indian 印度人	3
___ Eurasian 欧亚人	4
___ Others. Please specify 其他，请注明：___	5
11. <u>Combined</u> household income per month (check one) 平均每月的总收入。（请选一项）:	
___ less than $3,000 少于 $ 3000	1
___ $3,000 - $8,000 3000－ $ 8000	2
___ Above $8,000 $ 8000以上	3
12. How many children do you have 您有几个孩子？	
___ 1	1
___ 2	2
___ 3	3
___ 4 or more 4 或更多	4

THANK YOU!!!

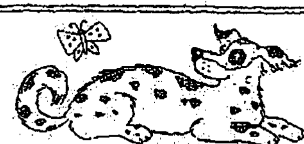
APPENDIX C1: Children Math Assessment (Pre)

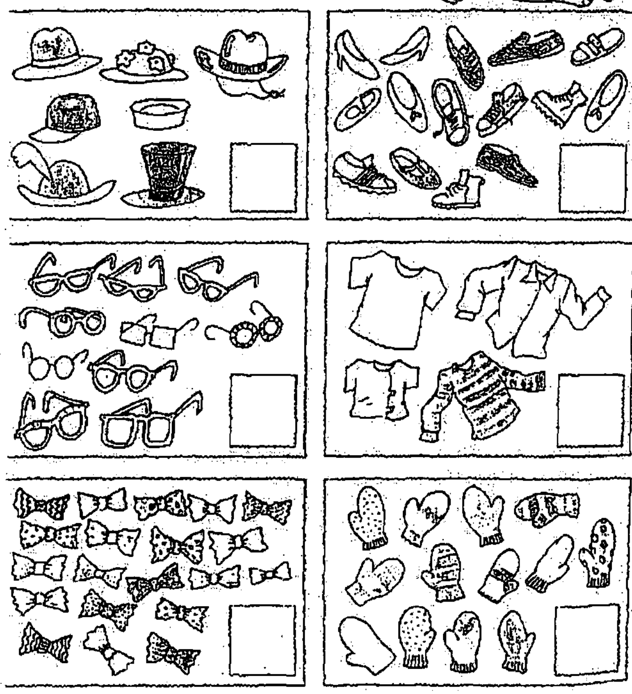
Name : ____________________
Class : ________ Date : ________

Revised (post KB) 15/6

How Many?

How many are there in each set?
Write the number in the box.

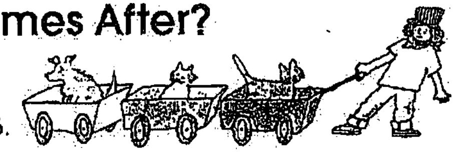




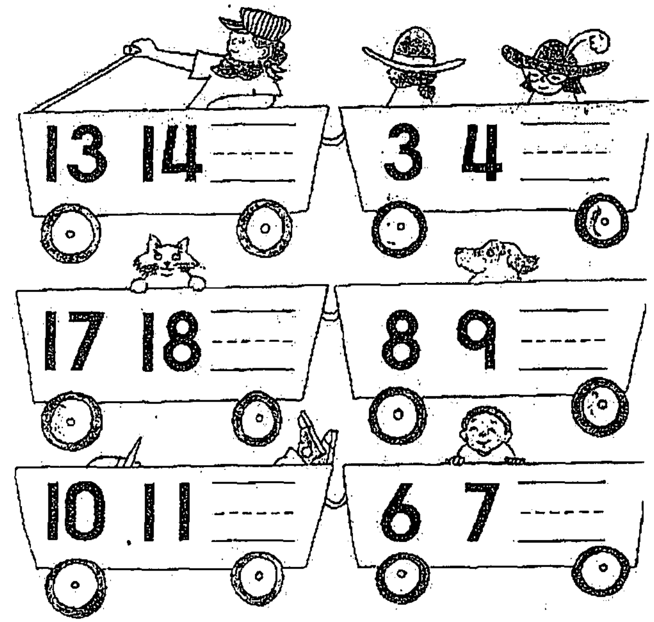
What Comes After?

5 6 7

7 comes after 6.

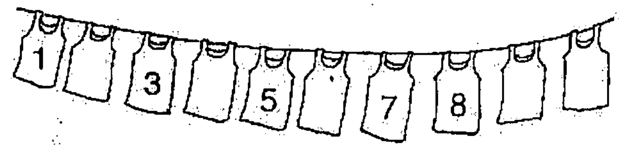


Write each number that comes after.

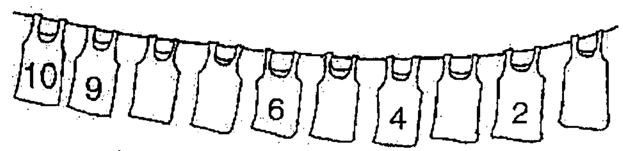


Write the missing numbers.

(a)



(b)



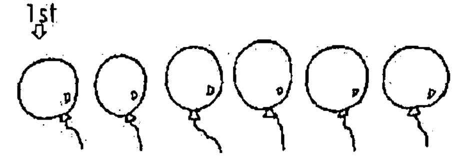
Colour the object in the correct position.

Use the correct colour written on each pencil.

1. Colour

2nd red

6th yellow



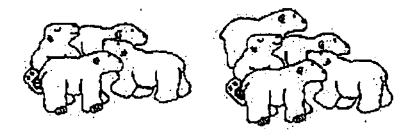
2. Colour

3rd green

5th brown

Circle the set that is greater.

1.



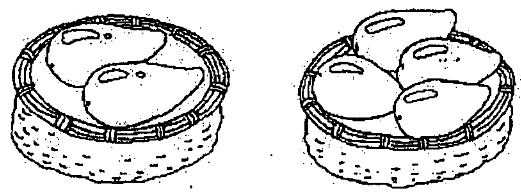
2.

3.

ontinued

8. Fill in the blanks.

(a)



In 1 basket there are **2** mangoes.
In another basket there are **4** mangoes.
How many mangoes are there altogether?

$\square \; + \; \square = \square$

There are ______ mangoes altogether.

(b)

Mother buys **6** pears.
Father buys **3** pears.
How many pears do they buy?

$\square \; \bigcirc \; \square = \square$

They buy ______ pears.

8. Fill in the blanks.

(a) John has **6** cakes.
He eats **2** cakes.
How many cakes has he left?

$\square \; - \; \square = \square$

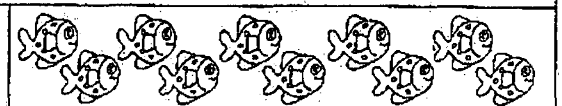
He has ______ cakes left.

(b) Mother had **5** eggs.
she broke **2** eggs.
How many eggs has she now?

$\square \; \bigcirc \; \square = \square$

She has ______ eggs now.

The graph below shows the pets in a pet shop.

Pets in a pet shop	
Fish	
Birds	
Terrapin	

Fill in the blanks.

(a) The shop has __________ types of pets.

(b) It has __________ fish.

(c) It has __________ terrapins

1. **Count and write the correct numbers in the blanks.**

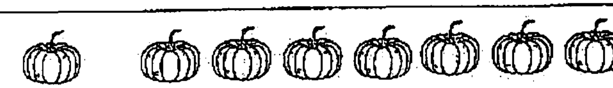
Example

$2 + \boxed{1} = \boxed{3}$

(a)

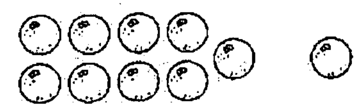
$2 + \boxed{3} = \boxed{}$

(b)



$1 + \boxed{} = \boxed{}$

(c)

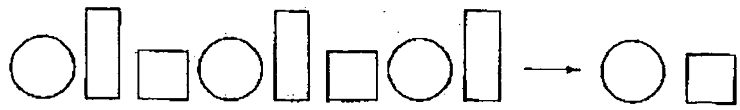


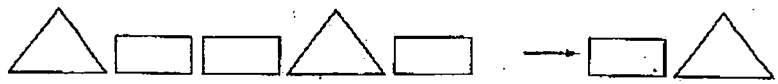
$\boxed{} + \boxed{} = \boxed{}$

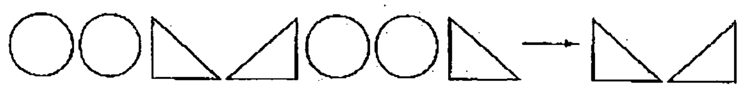
(d)

$4 + \boxed{} = \boxed{}$

D. Colour the pattern that comes next.

1. 

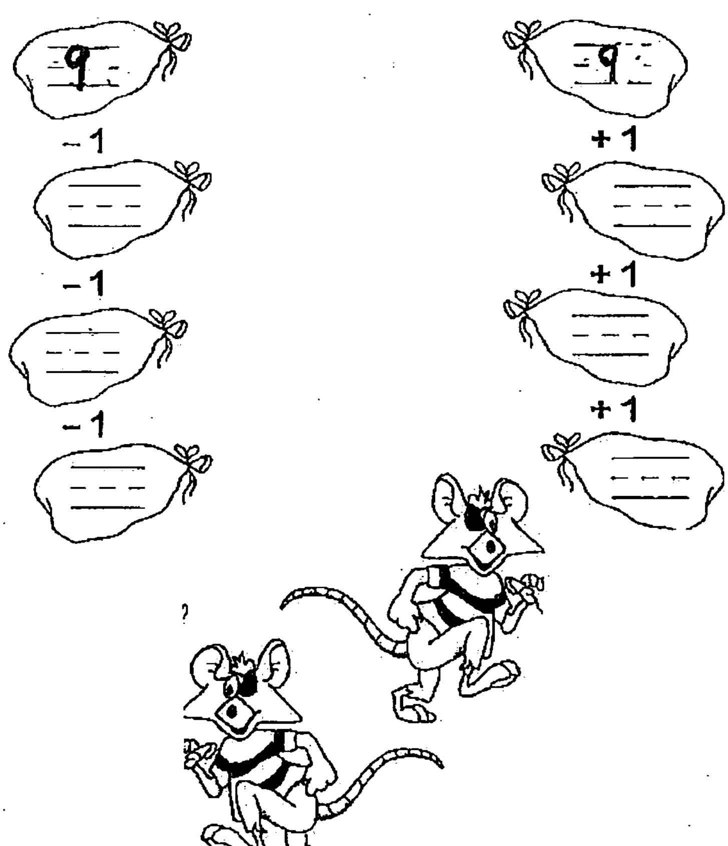
2. 

3. 

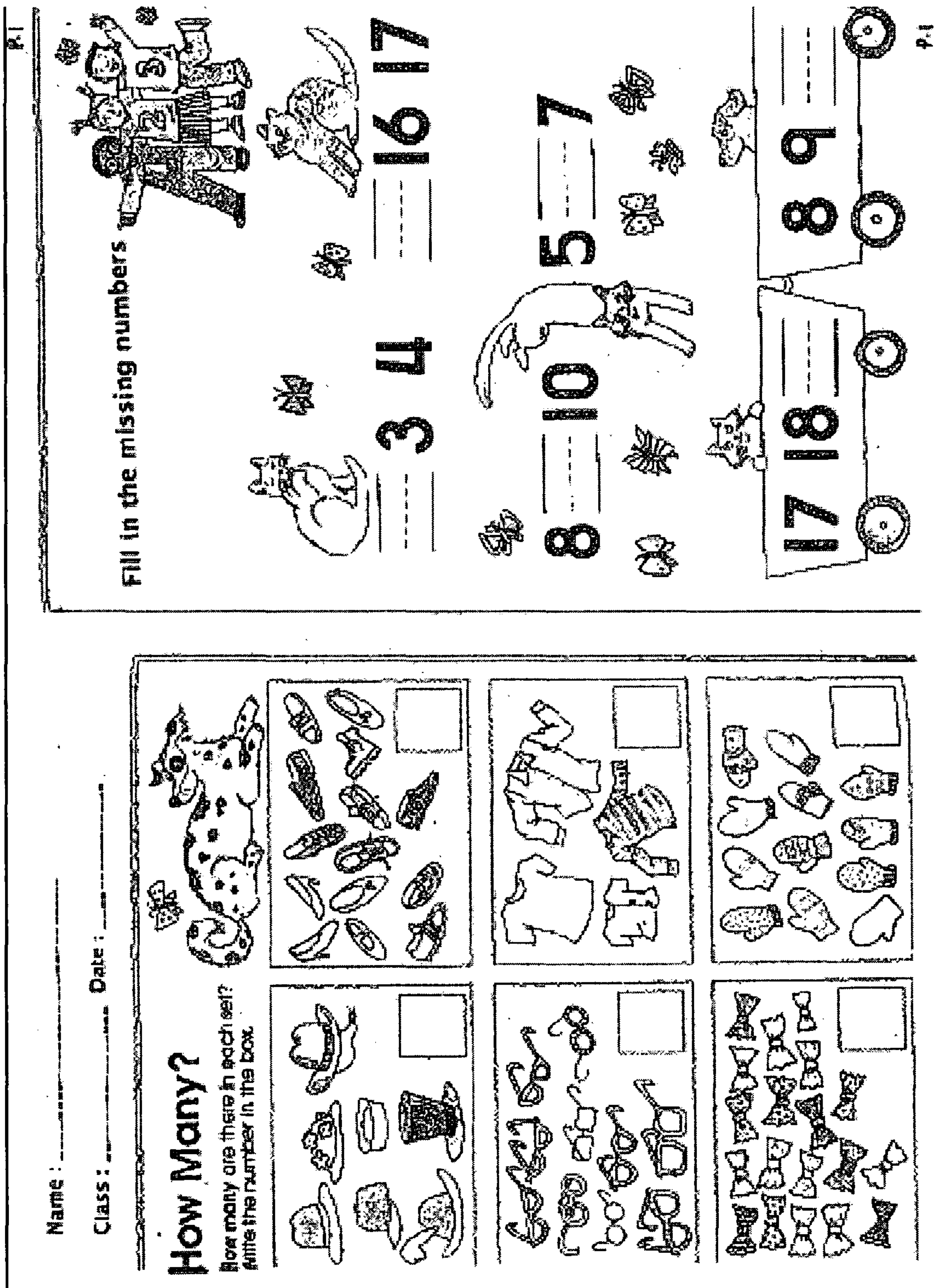
Bags of Gold

Skill Area: Mathematics—Number Patterns

Both pirates started with 9 gold coins.
How many do they have now? Add or subtract to find out.

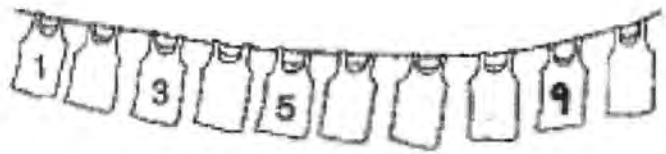


APPENDIX C2 : Children Math Assessment (Post)

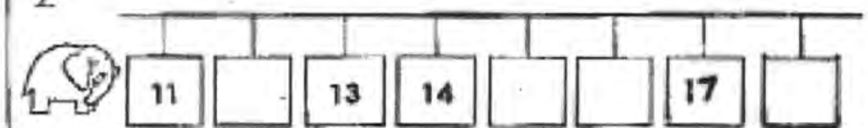


Write the missing numbers.

1.



2.



Colour the object in the correct position.

Use the correct colour written on each pencil.

1. Colour

3rd pink

4th blue

1st

2. Colour

10th orange

7th green

1st

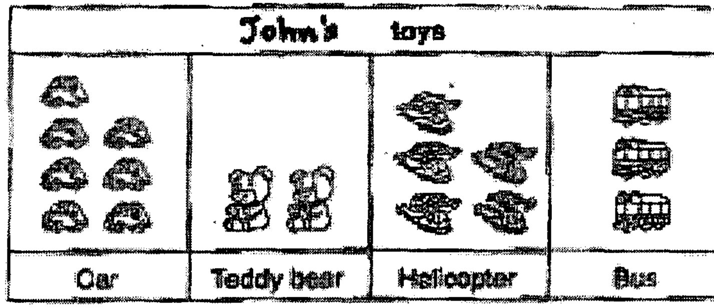
P.2

Circle the set that is **greater**.

1.

2.

3.



The graph shows John's toys.

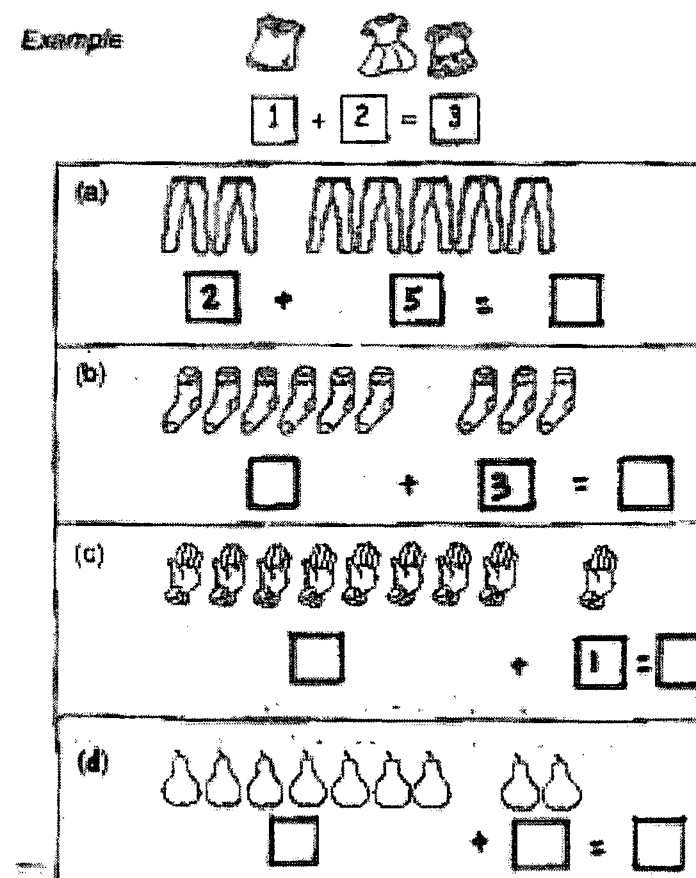
Fill in the blanks.

1. John has ______ types of toys.
2. He has _______ cars
3. He has _____buses.
4. Which set has less : helicopters or cars 7

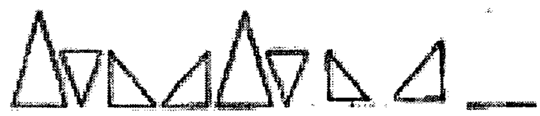
   Circle the set that has less.

P3

Count and fill in the blanks to complete the sums.



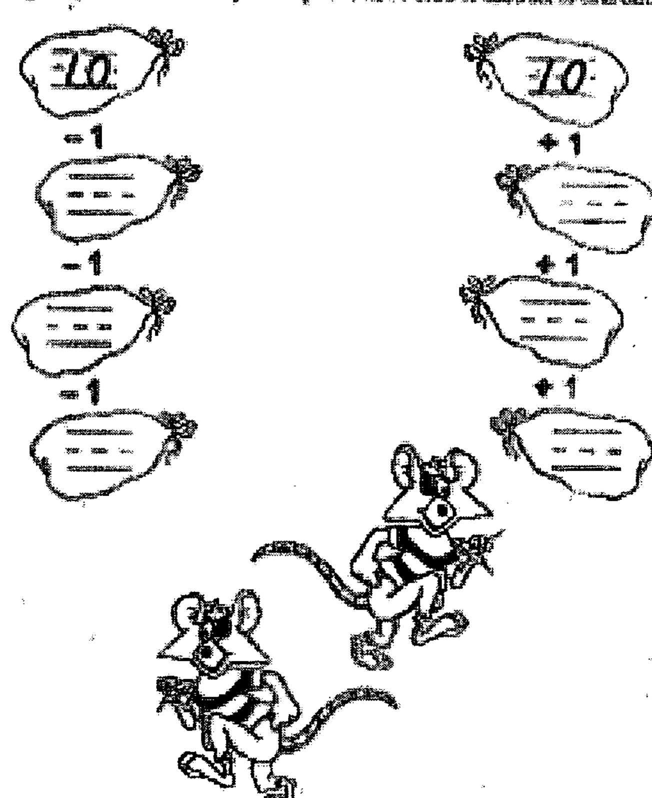
Draw the shape that comes next.



Bags of Gold

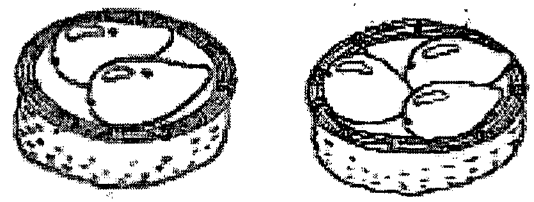
Skill Area: Mathematics—Number Patterns

Both pirates started with 10 gold coins.
How many do they have now? Add or subtract to find out.



Fill in the blanks.

(a)



In 1 basket there are 2 mangoes.
In another basket there are 3 mangoes.
How many mangoes are there altogether?

□ ○ □ = □

There are ______ mangoes altogether.

(b) Mrs Tan bought 4 apples.
Mrs Lee bought 6 apples.
How many apples did they buy altogether?

□ ○ □ = □

They bought ______ apples altogether.

P.5

(c) John has 6 cakes.
He eats 4 cakes.
How many cakes has he left?

□ ○ □ = □

He has ______ cakes left.

(d) At first there were 10 birds on the tree.
Then 5 birds flew away.
How many birds were left?

□ ○ □ = □

______ birds were left.

P.5

APPENDIX D : Newsletters (Issues #1-#3)

Family Math

Volume 1, Issue 1 14 July 2004

NTUC Childcare Cooperative Ltd

Inside this issue:

Parent Involvement in Maths

What Is the 'Family Math' Project?

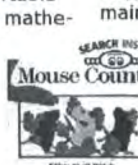
The Family Math Project is a communication program designed for families who would like their children to experience success in math. Some families may find it difficult to obtain assistance and resources for improvement. Parents may have little math education. Their children fall behind quickly. The Family Math Project supports parents to support their children by introducing activity-based math learning at home.

Research shows that students do better at school when their parents are involved in their education. Many parents, however, are not comfortable being involved in their child's mathematics education because it doesn't make sense to them or because they dislike mathematics.

Sometimes, the negative attitudes and fears of the parents are transferred to the children. Involvement in Family Math provides parents with the confidence to better

help their children enjoy and understand math.

'Family Math' aims to build a bridge between our childcare centres and families by helping parents to work and play with their children in order to develop positive attitudes towards mathematics. Parents and their children are encouraged to be actively involved in doing mathematics together. Given early support at home and in their community, children have an opportunity to maintain a positive attitude toward math through their school years. Doors remain open and options increase.



In every issue of 'Family Math' is a section called "The Literature Connection", which aims to introduce to parents some good number books to enjoy together. Visits to the local library to borrow books that are readily available will help to build up your child's vocabulary and understanding of

Family math activities

Whether they are done at home or in a class, FAMILY MATH activities are meant to be fun. There is no rush or need for immediate mastery or ideas. There is no test at the end, and nobody asks for a checklist of skills learned. You can take your time, continue an activity as long as children are interested, try new things, learn new concepts along with the children.

Especially at home, this is a wonderful opportunity to create and environment that makes math seem pretty special and attractive.

APPENDIX D CONTINUED

Doing Mathematics at Home

Children develop a love for reading when parents read to them on a regular basis. A love for mathematics develops in the same way. Parents can help their children see the patterns and relationships in mathematics by playing card games to practise basic skills, sorting laundry, cutlery or groceries, finding and discussing mathematics around the house (math walks) and talking about math in the daily world in which the child lives.

Recognizing a child's prior knowledge, and building on these early learning experiences, is essential for developing an understanding of mathematics. It is important for everyone to appreciate the value of "not knowing", and use these occasions as opportunities for growth rather than anxiety. Parents and leaders should not be critical of an incorrect answer nor be excessive in their praise of a correct one. Incorrect answers however should be corrected. When a family has fun learning together, and respects each other's thought processes, everyone benefits.

Recognizing a child's prior knowledge, and building on these early learning experiences, is essential for developing an understanding of mathematics.

Be supportive and model that maths can be fun !

Here are some ideas for you to consider as you and your family are doing mathematics at home :

- **Let your child know that you believe they can succeed.** Let them see you enjoying the activities, liking mathematics. Children tend to model and emulate their parents, and if a parent says "You know, this is really interesting!" that becomes the child's model.

- **Be more concerned with the processes of doing mathematics** than with getting a correct answer. The answer to any particular problem has very little importance, but knowing how to find the answer is a lifetime skill.

- **Provide a special place for study**, allowing your child to help you plan the study environment to suit his /her learning style.

- **Expect that homework will be done.** Look at the completed work regularly. But try to keep your comments positive. Praise your child for the effort put into the homework.

- **Don't expect that all homework will be easy for your child** or be disappointed that it seems difficult. Never indicate that you feel your child is stupid. Sometimes, loving and caring parents unintentionally give their children the most negative messages, for eg. "even your little sister can do that", or "Hurry up, can't you see that the answer is 10 ?" or "Don't worry, math was hard for me, too – and besides you'll never use It !"

- **Model persistence and pleasure with mathematics**. Include enrichment, recreational mathematics in your family routine. Try to introduce math ideas (with a light touch!) at the dinner table, or while traveling, even to the supermarket !

- **Seek out positive ways to support your child's teacher and school** Join the parent involvement activities organized by the school. Offer to help find materials. Accompany in field trips. Avoid making negative comments about the teacher or the school in front of your child – your child needs to maintain a positive feeling about the school.

Above all, enjoy mathematics !

Learning Targets : By the end of K2, children will be able to

- Count at least 20 everyday objects.
- Count forwards and backwards in ones, starting from a small number.
- Count forwards and backwards in tens (zero, ten, twenty, thirty ...)
- Read and write numbers to at least 20.
- Put the numbers 0 to 20 in order.
- Use the words *first, second, third...*
- Given a number from 10 to 20, say the number that is 1 more, 1 less, 10 more, 10 less.
- Use the words *add, sum, total, take away, subtract, difference between...* in practical situations.
- Know all pairs of numbers that make 10, e.g. 3 + 7, 8 + 2.
- Add and subtract two numbers under 10.
- Compare two objects or containers, and say which is longer or shorter, or heavier or lighter, or which holds more.
- Name and describe simple flat and solid shapes, e.g. *It's got 3 corners.*

These targets show some of the things your child should be able to do by the end of K2.

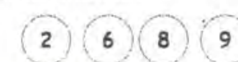
Some targets are harder than they seem, e.g. children who can count up to 20 may still have trouble saying which number comes after 12. They may have to start at 1 and count from there.

Fun activities to do at home

Adding circles

For this game, you need a dice and pencil and paper.

- Each of you should draw four circles on your piece of paper. Write a different number between 2 and 12 in each circle.
- Roll the dice twice. Add the two numbers.
- If the total is one of the numbers in your circles then you may cross it out.
- The first person to cross out all four circles wins.



Car number bingo

- Each person chooses a target number, e.g. 10. Think about which pairs of numbers add to make your target.
- You have to see a car that has two numbers that add up to your target number.
- Say: *4 + 6 = 10, bingo!*
- Change the target number each week.

You can extend this activity by looking for three numbers which add up to your target number.

APPENDIX D CONTINUED

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Look our for great ideas for math activities you can do at home at these websites :

http://www.mathsurf.com/parent/index.html

The Literature Connection : Recommended books for you and your child

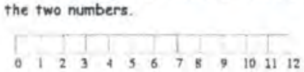
Here are some great book titles by Mary Packard, Mick Inkpen, Pat Hutchins and Anno Mitsumasa to look out for at your next visit to your nearest library. These books tap on children's rich imagination while introducing mathematical concepts at the same time and they make wonderful bedtime stories too !

Dice game

You need a 1-6 dice, paper and pencil.

- Take turns.
- Choose a number between 1 and 10 and write it down.
- Throw the dice and say the dice number.
- **Work out the difference between the chosen number and the dice number, e.g. if you wrote down a 2 and the dice shows 5, the difference is 3.**

You could also draw a number line to help your child to see the difference between the two numbers.



Secret numbers

- Write the numbers 0 to 20 on a sheet of paper.
- Ask your child secretly to choose a number on the paper. Then ask him / her some questions to find out what the secret number is, e.g. Is it less than 10? Is it between 10 and 20? Does it have a 5 in it? He / she may answer only yes or no. Once you have guessed the number, it is your turn to choose a number. Your child asks the questions.For an easier game, use numbers up to 10. For a harder game, use only 5 questions, or use bigger numbers.

LESSONS FROM THE CLASSROOM

Dear Parents,
Here are some examples of math lessons taught in the K2 classroom during this period. You can try them out at home as well !

From Jurong Centre :

ACTIVITY : SEQUENCING

LEARNING OUTCOMES : Children will be able to order numerals and complete the missing numbers

Materials : Number cards 1-20, paper with 31 blank squares

PROCEDURE ; Children will be given number cards from 2-30. teacher gives a recording sheet that contains 31 blank squares set up like a calendar in rows of 7. Teacher numbers the first square '1' and the last square and allows children to arrange the cards in the correct order / sequence. If children are not sure how to do this, they can look and refer to a calendar.

ACTIVITY : BEANS OR M&M's IN A JAR - ESTIMATION / GUESSING

LEARNING OUTCOME : Children will be able to estimate and guess (1-20) the number of objects

PROCEDURE :

Teacher shows children an empty jar which is transpaparent. She then puts some kidney / vroad beans between 1-10 n the jar. She then asks the children to look at the beans and guess how many beans are in the jar. The beans are then oured out and counted with the the children. The number of beans can be increased gradually to 20, 30, 40 etc.

It is important that the teacher /adult helps children to estimate by asking, "Is there more than or less than _____ (a certain number, say, 10). How many think it is more than 10 ? How many think it is less than 10 ? etc.

APPENDIX D CONTINUED

TOPIC	LEARNING OBJECTIVES
COUNTING – COUNTING ON AND COUNTING BACK	• Count at least 20 everyday objects. • Count forwards and backwards in ones, starting from a small number. • Count forwards and backwards in tens (zero, ten, twenty, thirty...) • Read and write numbers to at least 20.
ORDINAL NUMBERS	• Arranging and naming objects lined up in an order (1st, 2nd, 3rd ......10th) starting from the left or Right side. Use the words *first, second, third...*
NUMBER LINE	• Put the numbers 0 to 20 in order. • Given a number from 10 to 20, say the number that is 1 more, 1 less, 10 more, 10 less. • Develop concepts of number system and place value. Counting and recognizing numerals up to 100

1 2 3 4 5 6 7 8 9 10 11 12 ...

MATH RESOURCES ON THE INTERNET

For those of you who may be interested in MORE math resources and some online math games for children age 6-9 years, you can find a number of interesting ideas at the following websites :

http://www.lessonplanspage.com/MathK1.htm
http://www.sitesforteachers.com/resources_sharp/math/math_games.html

Connect Four. Connect Four provides kids in grades 3-8 easy-to-follow rules and an attractive gameboard for playing this popular logic game on the Web. Another online game of connect four, the old version or the new version has an advantage of offering three levels of difficulty for kids in grades 2-12. For the ultimate connect four game with most customizing features, click here .

Dots. Dots, created by John Chuang, is an online version of the popular connect-the-dots strategy game for grades 3-8. Your goal in this player vs. computer game is to capture as many boxes as possible. For a Java version of the game, click on Dots and Boxes.

Fruit Game. Fruit Game, for students in grades 4-8, is an online version of the classical logic game of Nim. You compete against the computer removing fruit from a table, and the player who takes the last fruit from the table is the loser. New players should read the rules first.

Slider Puzzle. Slider Puzzle is an online version of the classic 16 square logic game where you try to arrange in order the numbers 1-16.

ENJOY !!!

APPENDIX D CONTINUED

NTUC Childcare Cooperative Ltd

Volume 1, Issue 2

29 July 2004

Family Math Newsletter

Doing Mathematics with Your Child

Parents have the wonderful opportunity and responsibility for nurturing children. This nurturing process takes place in several areas of development: physical, emotional, and intellectual. While parents can usually find time to read a story to their children, thereby instilling a love for literature, they are often at a loss as to how to instill a love and appreciation for mathematics.

Like reading, mathematics is a subject that is indeed necessary for functioning adequately in society. More than that, mathematics is a subject that should be more enjoyable than it sometimes is. The appreciation and enjoyment of mathematics is one of the national goals for mathematics education. This goal, coupled with the task of nurturing children's confidence in their ability to apply their mathematical knowledge to solve real-life problems, is a challenge facing every parent today.

This article presents resources that will enable parents to fulfill their responsibility for developing their children's abilities to do mathematics, while at the same time encouraging more positive attitudes toward mathematics.

Activities in the Home

There are methods by which parents can easily become involved in their children's mathematics education. Several resources provide parents with games and activities that engage children in mathematical thinking and problem solving and, at the same time, build their self-confidence and appreciation for mathematics.

Parents' attitudes toward mathematics have an impact on children's attitudes. Children whose parents show an interest in and enthusiasm for mathematics around the home will be more likely to develop that enthusiasm themselves.

Reading to children is a treasured activity in many homes. What better way to integrate mathematics into the lives of children than to read them stories that bring mathematical ideas to life? Children's books related to mathematics can be separated into four categories: counting books, number books, storybooks, and concept books.

Inside this issue:

What happens when parents are involved ?

- Parents become productively involved in their children's education
- Parents appreciate teachers' guidance
- Parents may experience increased efficacy for helping their children learn

APPENDIX D CONTINUED

....Activities in the Home

- Your child does not only learn in school
- You were your child's first teacher
- Children can be helped at home in many ways
- A lot of these ways are easy and need not stop you getting on with other things you have to do

Talking and Listening

- Try to answer your child's questions and ask questions yourself about what your child is doing
- Do things with your child and talk about them as you do them
- Nursery rhymes, stories, number rhymes are important
- Talk about pictures in books and magazines, newspapers

These things can help your child learn maths :

- Different sizes of cooking pots/pans with lids to fit
- Plastic containers of all sizes and shapes
- A box of assorted buttons
- A collection of different sized empty boxes
- Washing up bowls, sieve, colander, squeezy bottles, funnel and sponge
- Nails, screws, nuts and bolts from the toolbox
- Old newspapers, magazines

What can it teach your child ?

The following are two examples from the above list :

- A set of cooking pots/pans
- These can teach your child that :
- They are the same shape, that some will hold more when filled with liquid
- One is bigger than another
- There is a biggest one and a smallest one
- Only one lid will fit one particular pan
- They can fill them with water, etc

A collection of buttons

These can teach your child :

Different sizes, shapes, colours

- That some have holes at the back, and some have holes through them
- Some are rough and some smooth, shiny, dull, patterned or not patterned
- Let your child sort them into different piles and tell you which is the biggest pile, the smallest pile, or how many there are in a pile. Old margarine /ice cream tubs / empty egg cartons can be used to hold different piles

What you do in the home will help your child learn :

- Getting dressed – in a definite order, pairs of socks, how many buttons, matching buttons to buttonholes etc
- Time – the order of the day – breakfast time, lunch time, dinner time, bed time, time to go to school etc Use words such as 'before', 'after'
- Laying the tale – one thing for one person, cutting up the pizza in equal parts or portions, small and large portions, different sizes of cups – which one holds the most ?
- Cooking – measuring, weighing, cutting, playing with dough for pleasure, dividing up the dough
- Helping – digging in the garden, washing the car, helping to do odd repair jobs – carrying things, wrapping things, explaining about length, weight, volume and capacity
- Shopping – lots of possibilities for talking about quantity, weights, size, price, total costs
- Playing in sand and water (including bath time) – especially filling one container from another, seeing containers of different shapes can hold the same amount of water etc.

APPENDIX D CONTINUED

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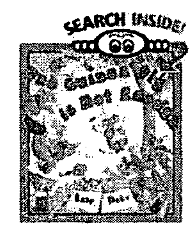
The Best Bug Parade
The bugs are on parade! One is big, the next is bigger, and the next is the biggest bug of all. Learning how to compare and contrast sizes is an important early math skill and one of the most basic forms of mathematical reasoning. In *The Best Bug Parade* children are introduced to this concept by some goofy-looking bugs who form a parade. Author **Stuart J. Murphy** and illustrator Holly Keller have made comparing sizes an enjoyable activity for the very youngest math student.

The Math-Literature Connection : Recommended Books

Anno's Counting Book by Mitsumasa Anno

This wordless book begins with the number 'zero' and ends with '12'. Anno uses clever imagery and simple illustrations to represent the different numbers, including unifix link cubes. It is a delightful 'story' that can be told and invented by both parent and child as there are no words to limit your imagination !

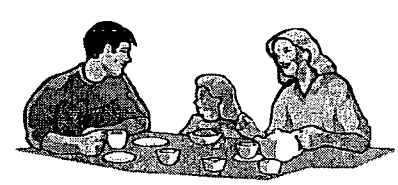
Mr Anno believes that children enjoy the playful, puzzle-solving aspect of mathematics and that they use their natural mathematical abilities in many ways as part of their daily lives.



One Guinea Pig is not enough
By Kate Duke

Kate Duke has created 10 adorable guinea pig characters, with each up to a little mischief. The story is built on the playful antics of 10 friends and ends up with a heart-warming reunion with their mums and dads. The story is told as a number rhyme and has clear numerals in the illustrations for children to look at and follow.

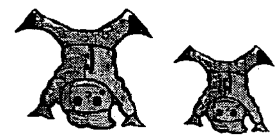
These words are used in maths – use them at home as well !



Words used with MATCHING / COMPARING	Words used with ORDER	Words used with COUNTING	Words used with PATTERN	Words used with SHAPES	Words used with CONSERVATION
SMALLER, BIGGER SAME, DIFFERENT EXACTLY, NEARLY ALMOST, MOST LEAST, MOST	FIRST, LAST NEXT, ORDER MIDDLE, MOST, LEAST BIG, BIGGER, BIGGEST	UP, DOWN FIRST, NEXT, LAST AGAIN, MORE EARLY COUNT ON COUNT BACK	MORE THAN, LESS THAN BEFORE, AFTER A LOT THE SAME AS DIFFERENT ON TOP UNDER	SAME, DIFFERENT SMALL, BIG STRAIGHT SQUARE CIRCLE TRIANGLE COMPLETE NEARLY MORE	LONG, SHORT TOO MANY, TOO FEW MORE, SAME EXACTLY LONGER, LESS DIFFERENT

APPENDIX D CONTINUED

From the K2 Classroom (Bedok Centre)



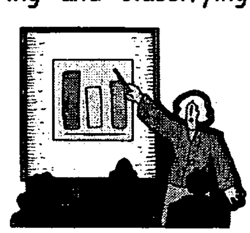
On 7th July 2004, we went to the NTUC Fairprice Supermarket at Bedok North St 1. At the supermarket we learnt how food can be classified according to the different groups i.e. fruits, vegetables, seafood, meat, poultry and dairy products. We saw these categories of food labeled and arranged neatly in different sections of the supermarket.

While we were there, we also bought some items for the Supermarket Corner as well as our Home Science activities, which we will be doing, in the coming weeks. We also learnt that money is used for buying these items that we needed. After making our purchases, we queued happily at the cashier's counter just to pay for the items which we picked. It was exciting to see how the cashier registered the items and how it went 'beep' when each item was scanned !

Back in our classroom, we had a discussion and sharing session and we found out what each of our favourite fruit. Our teacher then helped us to carry out a Maths activity on graphs, which was based on our favourite fruit. We learnt to use words like "more than, less than" and "altogether". Our counting skills were reinforced and we also learnt simple addition and subtraction from the graphs !

The trip to the Supermarket was very enjoyable for all of us. Next time when our parents take us to the supermarket, we will have no difficulty identifying and classifying the food easily.

Done By:
The K2's of Bedok NTUC Childcare



APPENDIX D CONTINUED

Family Math Newsletter

Volume 1, Issue 3 16 August 2004

NTUC Childcare Cooperative Ltd

Inside this issue:

Special points of interest:

Sorting

Children should be able to notice things that are alike and be able to sort them out of mixed groups. Using a department store catalog or newspaper insert, ask your child to tell in which room the item would most likely be found. Or, have the child point out as many items as possible that may be found in a particular room.

Building a Strong Math and Science Foundation at Home

Solving Problems

First, help children of any age become good problem solvers. Here are some tips:

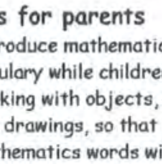
1. Encourage questions, particularly those that have more than one possible answer, and preferably ones to which you don't know the answer yourself. ("I'm not sure why leaves have different shapes--let's collect some and try to figure out some reasons.")

2. Ask open-ended questions and welcome innovative responses. ("What do you think these woods will look like a hundred years from now?" "What would children do if there weren't any schools and everyone stayed home and learned from a computer?")

3. Encourage divergent approaches to everyday situations, within reason. (If your child can think of a reason for setting the table in a new and different way, why not?)

4. Help your child to tolerate some uncertainty--effective thinkers can delay the best solution to a problem until they've tried out several hypotheses.

5. Provide toys and games that encourage a variety of types of play that the youngster must create himself; praise and admire innovative uses of play construction or game materials.



Parents can help children learn mathematics

All parents want their children to enjoy school and succeed with schoolwork. They are eager to help children learn mathematics, but many are not sure how to proceed.

Parents can help children develop mathematical concepts and build vocabulary, and they can foster an attitude of curiosity about numbers and shapes.

Guidelines for parents

1. Introduce mathematics vocabulary while children are working with objects, pictures and drawings, so that new mathematics words will have meaning.
2. Show personal interest in children's activities that involve number and shape. Do some of the listed activities together

with your child. Let him/her know you are excited that they are learning about numbers and shapes. Value highly whatever progress children make in learning mathematics

3. Whenever children count, measure, or collect other quantitative information, encourage them to make a record of what they find. They may select or write numerals, make simple graphs, or possibly make drawings. Sometimes they can make a book that records different stages in a project - complete with pictures eg. Growing red / green beans. In so doing, children will understand that the numerals are a record of 'how many' and the words tell about what they did.
4. Play mathematics games with your children - lots of suggestions for you here.
   How many did I take ?
   The 1st player matches two sets of objects one-to-one and shows that both sets have the same number of objects. While the other player closes his eyes, the first player scrambles all the objects together, then removes some from one set. The other player tries to find how many were removed by pairing the sets again.
   A variation of the game uses only one set of objects, possibly a set of 7 beans. The first player covers part of the set with his hand and has the other player tell how many are under the hand. The objects are then uncovered to see if the number given by the other player is correct.

Children can be involved in mathematics activities in varied settings at home, both indoors and outdoors. The lists of suggested activities that follow are organized by settings so that parents can more easily integrate mathematics with the child's other activities. It is important that the interaction with your child be relaxed, at the child's level of development and ability.

Young children can help with activities in these rooms. Preschool children can do the following :

Math Games by Jurong Centre

Activity 1: Counting and Eating Peanuts.

Objective: Counting, one-to-one correspondence.
Materials: Peanuts
Procedure: Make five piles of peanuts. Each pile should contain a different number of peanuts. Ask the child to make guess of how many peanuts there are, and then count the number of peanuts. If the child makes a correct guess, the child would get to eat that pile of peanuts.

Activity 2: Math Spy

The children are to go to any part of the houses and look for: 1) Patterns and 2) An object whose length can be measured using ice-cream sticks. After that, the child is supposed to draw the pattern of the object and describe the pattern to his/her parents. The child is also supposed to draw the object and state that is ____ ice-cream sticks long.

Activity 3 : Matching with cards

Objective: Matching sets, one-to-one correspondence, counting, numeral recognition, taking turns.
Materials: Deck of playing cards with face cards removed.
Procedure: Place playing cards on the table one through ten. Place the rest of the deck cards next to the ones that are spread out. The child will then try to match the top card of the deck with one of the displayed cards. The child doing the matching should be encouraged to count the spots on the cards and read the nu-

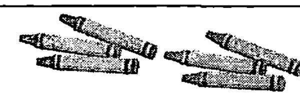
Make a Number line

Materials
A set of number cards from 0 –20, dot-cards with numerals, string, clothes pegs, and a wall that is long enough to place this number line
Purpose
To order numbers

1 2 3 4 5 6 7 8 9 10 11 12...

Activity
1. Give your child 5 cards to arrange in order on the floor.
2. Decide which side to begin the number line (ie. Left side)
3. What is the number to begin our line ?
4. What is the next number ?

One more, one less



Materials : Beans, macaroni, bottle caps etc Number line

Purpose : To demonstrate and encourage counting on from any number

Activity
1. Ask your child to take three beans or to show three fingers. Then ask your child, can you show me 'one more' than 3 ? 4 ? 5 ? Refer to the number line and ask the child to point to the number that is 'one more' or 'one less'
2. Try counting on using the worksheet 'Flowers' and 'Add 1', 'Subtract 1'

Discussion / extension1.
Write the numbers on a paper. Ask can you see them on the number line ?
2. Read the story 'Let's count it out, Jesse Bear' by Nancy White Carlstrom or 'One guinea pig is not enough' by Kate Duke

Takings - A game with dice

For this game you will need a dice and a collection of small things such as Lego bricks, sticky shapes or dried beans. You will also need pencil and paper.

- Take turns.
- Roll a dice. Take that number of beans. Write down the number.
- Keep rolling the dice and taking that number of beans. BUT, before you take them, you must write down your new total.
  For example, Sally has 7. She throws 4. She has to work out how many she will have now. She starts counting from seven: *eight, nine, ten, eleven*. She writes 11.
- You can only take your beans if you are right.

The first person to collect 20 beans wins!

In the Kitchen and Dining Room

(Cont'd from p. 2)

- Sort cutlery into sets of spoons, knives, forks and spoons (Classifying)
- Place a paper napkin at the left of each plate. Fold napkins as rectangles one day, then as triangles the next (Matching - geometric shapes)
- Compare pots and other containers in the kitchen. Ask, "Which hold most water ? Which holds the least ?" (Comparing volumes)
- Order pots by size. Order cans by diameter (Ordering)

- Find the number of chairs needed to match places set at the dining table (Matching : cardinal numbers)
- Count beans, Ask " How many beans are in the bowl ?" (cardinal numbers)
- Find how many Yakult bottles /plastic cups of water it takes to fill a pot (cardinal numbers. Measuring volume)

APPENDIX D CONTINUED

Volume 1, Issue 3 Page 4

Let's Go Shopping!

Children love story telling and what better way to incorporate it into their learning? This activity will not only get children to participate actively, but they can also plan their own storyline and play it later.

Materials needed:
- Shopping cart Template (Refer next page)
- Counters
- Story cards

How to play:
- ☺ Give your child the template of the shopping cart and some counters.
- ☺ Start by pretending that you and your child are going shopping.
- ☺ You then start adding items to your cart in by telling him a story for e.g. Mummy wants to make omelettes so I need to 3 eggs (Your child will then add 3 counters to the egg portion). Mummy then wants 1 loaf of bread to go along with the omelette so your child will then add 1 counter to the bread portion. Ask your child how many items he has left.
- ☺ You may continue adding and subtracting using the story cards.
- ☺ Once your child gets the hang of the activity, you may provide some story cards for your child so that he can use the story cards and play the activity on his own.

An activity suggested by Sembawang Centre

Checklist for Helping Your Child With Homework

1. Show That You Think Education and Homework Are Important

___ Do you set a regular time every day for homework?
___ Does your child have the papers, books, pencils and other things needed to do assignments?
___ Does your child have a well-lit, fairly quiet place to study?
___ Do you set a good example by showing your child that the skills he is learning are an important part of the things he will do as an adult?
___ Do you stay in touch with your child's teacher?

2. Monitor Assignments

___ Do you know what your child's homework assignments are? How long they should take? How the teacher wants you to be involved in them?
___ Do you see that your child starts and completes assignments?
___ Do you read the teacher's comments on assignments that are returned?
___ Is TV viewing or video game playing cutting into your child's homework time?

3. Provide Guidance

___ Do you help your child to get organized? Does your child need a schedule or assignment book? A book bag or backpack and a folder for papers?
___ Do you encourage your child to develop good study habits (for example, scheduling enough time for big assignments; making up practice tests)?
Helping Your Child with Homework/final manuscript 07/18/02 26
___ Do you talk with your child about homework assignments? Does she understand them?

4. Talk with Teachers to Resolve Problems

___ Do you meet with the teacher early in the year before any problems arise?
___ If a problem comes up, do you meet with the teacher?
___ Do you cooperate with the teacher to work out a plan and a schedule to solve homework problems?
___ Do you follow up with the teacher and with your child to make sure the plan is working

APPENDIX D CONTINUED

NTUC Childcare Cooperative Ltd

Look out for great Math ideas and Fun activities you can do at home with your child at :

http:// www.geocities.com/ EnchantedForest/ Dell/5232/ and http:// nie.redding.com/ community/nie/ activities/ act_family_math1.shtm

The Maths-Literature Connection : Recommended books

Let's Count it Out, Jesse Bear
By Nancy White Carlson

A delightful story told in rhyme and introduces both numerals and number words in the context of everyday settings and experiences that children can relate to. Each page progresses to the next number and is introduced as 'and one more'. The illustrations are attractive and engaging and give children lots of items to count. A great number book that introduces the key language of maths.

Anno's Magic Seeds by Mitsumasa Anno
The magic begins when a wizard gives jack two mysterious golden seeds. Jack eats one seed and miraculously, isn't hungry for a whole year !He buries the other seed, just as the wizrd has told him to do and suddenly his life starts to change. Though the story can be followed without any math skills beyond simple addition and subtraction, sharp-witted young readers will delight in the increasingly tricky arithmetic pyzzles cleverly woven into both text and illustrations.

Give Me Half !
Splitting things in half may seem like an easy thing to do, but when two siblings and a pizza are involved, things can get messy.Children learn about fractions at school but fractions are also an important part of everyday life outside the classroom.In this riotous book, Stuart J. Murphy and G. Brian Karas introduce the simplest of fractions, 1/2.

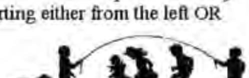
Ordinal Numbers

Materials
Cards with 1st, 2nd, 3rd...10th written on them, 2 cards 'Left' & 'Right' and 10 assorted objects eg. Pencil, eraser, straw, sweet, couloured blocks etc

Purpose
Develop concepts of position / ordering from left to right and right to left

Activity
1. Arrange the 10 objects in a row and let your child place the cards according to the order of each item, first from left to right, and then later, form right to left.
2. Ask your child, "Which is the 3rd object from your left ?" and "Which is the 5th object from your right ?" etc.

Discussion
Parents can help children learn the position of objects lined up in a row, starting either from the left OR right side.



Number Bonds

Materials
A board for each player which is a drawn out 4 x 3 matrix with the numbers 1– 12 written in the squares, and counters (buttons, beans, beads etc) for each player, two dice

Purpose
Simple addition and number bonds

Activity
1. Players take turns throwing the 2 dice. If the player is able to make a number to 1-12 by adding or subtracting the two numbers on the dice, then he or she puts a counter on top of that square on the matrix. The winner is the first player to cover all the numbers on his /her own matrix.
2. The game can be adapted by using dice with different numbers, changing the size of the matrix on the board, or introducing a third dice.

APPENDIX D CONTINUED

PARENT INVOLVEMENT STUDY

NTUC Childcare Cooperative Ltd

12 September 2004

THANK YOU FOR YOUR PARTICIPATION

Dear Parents,

It has been a pleasure and a most enjoyable experience as I worked with you and the team of teachers and principals at the child care centres during the past couple of months. I would like to thank you for your GREAT participation in the Family Math Workshops during the past 4-6 weeks.

I hope you had a fruitful and enjoyable time finding out how you can support your child's math learning at home through the ideas shared during the Math workshops and the Math Activity Kits.

To recap, the **objectives** of the math workshops are :

- Give parent and child a risk free environment to experience math activities
- Allow parents to see how something fun can also be concept building and educational
- Help parents gain insights into the math curriculum
- Enable parents to work with their child to practise skills for mastery and reinforcement at home
- Encourage parents to engage in home activities that would promote both parental success and pupil's self-confidence
- Provide periodic group meetings for parents that include an explanation of the curriculum;

The following pages will provide a pictorial summary of the different math concepts that were covered during the Family Math workshops held at the different centers from Jun-Aug.

Yours sincerely,

Mrs Lim-Chan Lin Ho
Principal Investigator

APPENDIX D CONTINUED

ADDITION AND SUBTRACTION – NUMBER BONDS 	• Develop concepts of addition and number bonds • Explore the relationship between addition and subtraction. • Use the words *add, sum, total, take away, subtract, difference between...* in practical situations. • know all pairs of numbers that make 10, e.g. 3 + 7, 8 + 2, etc • Investigate different ways a number can be expressed as a sum (number bonds) • Understand that addition is a process of putting things together • Add and subtract two numbers under 10



CREATING PATTERNS using shapes and objects	• Practise creating and copying patterns (eg. AB AB or AA BB • pattern) • Creating and extending simple linear patterns • Naming simple shapes
GRAPHING AND COMPARING SETS	• Counting, comparing, organizing information • Learn to read a simple graph. • To sort any collection of items according to shape, colour, size, use etc. • Recognise and count small sets • Compare items in a set—1 to 1 correspondence • Using counting to verify equal or non equal sets • Using counting to determine cardinality of sets



APPENDIX D CONTINUED

YOUR FEEDBACK.....

Dear Parents,

Thank you very much for your participation in the parent involvement study. Attached to this letter is a follow-up questionnaire for your completion. Your honest feedback to the questions would be very much needed and appreciated as we would like to continue to add new ideas and ways to improve our communication and support for parents . Kindly return the questionnaire in the envelope and return it (sealed) to me by 30 September, Thursday, 2004.

If you have any questions or clarification on the study, please feel free to contact me or drop me an e-mail at :

Blk 70 Geylang Bahru
#02-2719 SE 330070 Tel : 63919223 Fax : 62933460
E-mail : linho@rtrc-asia.com

We hope that your child will have a smooth and enjoyable transition into Primary One. Here are also some tips on helping your child with homework in the months ahead.

Here's Wishing you the Very Best in your partnership with your child and his/her school in the years ahead !

Yours sincerely,
Mrs Lim-Chan Lin Ho
Principal Investigator

Checklist for Helping Your Child With Homework

1. Show That You Think Education and Homework Are Important

___ Do you set a regular time every day for homework?
___ Does your child have the papers, books, pencils and other things needed to do assignments?
___ Does your child have a well-lit, fairly quiet place to study?
___ Do you set a good example by showing your child that the skills he is learning are an important part of the things he will do as an adult?
___ Do you stay in touch with your child's teacher?

2. Monitor Assignments

___ Do you know what your child's homework assignments are? How long they should take? How the teacher wants you to be involved in them?
___ Do you see that your child starts and completes assignments?
___ Do you read the teacher's comments on assignments that are returned?
___ Is TV viewing or video game playing cutting into your child's homework time?

3. Provide Guidance

___ Do you help your child to get organized? Does your child need a schedule or assignment book? A book bag or backpack and a folder for papers?
___ Do you encourage your child to develop good study habits (for example, scheduling enough time for big assignments; making up practice tests)?
___ **Do you talk with your child about homework assignments? Does she understand them?**

4. Talk with Teachers to Resolve Problems

___ Do you meet with the teacher early in the year before any problems arise?
___ If a problem comes up, do you meet with the teacher?
___ Do you cooperate with the teacher to work out a plan and a schedule to solve homework problems?
____Do you follow up with the teacher and with your child to make sure the plan is working

APPENDIX D CONTINUED

FOCUS GROUP INTERVIEW
AN INVITATION TO PARENTS WHO ARE INTERESTED....

As a follow-up to the study, I will be conducting a follow-up focus group interview for parents who have participated in the study. Hence you are invited to join in this short group interview.

If you would like to participate , please complete the attached form with your contact particulars and I will keep you informed of the date, time and venue for this informal discussion. However, as the group size will be limited to 6-8 persons, there may be a need to select participants if the response is overwhelming. I will keep you informed on the grouping and schedule.

The discussion will be conducted in English and it will take about 1- 1 ½ hours and will be held on a Saturday morning (in Sep/October) at the NTUC Childcare Head office at Geylang Bahru. During the discussion, I hope to find out more from parents whether the Family Math newsletters have made any impact or changed your approach to helping your child learn math at home. I would also welcome other feedback you may have on the study.

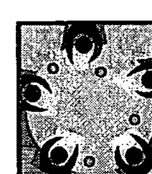
✂---

PARENT INVOLVEMENT STUDY (FAMILY MATH NEWSLETTERS)
FOCUS GROUP DISCUSSION

Yes, I would like to participate in the Parent Focus Group discussion on the Family Math Newsletters. Please contact me at :

Tel : ______________________(O) ______________________(HP)

E-mail : ________________________________ (optional)



Name (Parent) : ________________________________

Child's name : ________________________________

Name of Centre (Branch): ______________________

(Kindly detach this form and return it to Ms Chan at the above address, OR through the center principal by 17 September, Friday 2004)

APPENDIX E : Content, Objectives and Methods for Parent Workshops

Each of the workshop sessions will be 2-2.5 hrs in duration. The possibility of conducting combined workshops for the 3 E2 groups is still being weighed in view of the large group sizes as well as the need to standardise the intervention. If done separately, then the sessions would most likely be conducted at the child care centres since materials for the workshops are readily accessible there.

	Title	Objectives / Content	Methods
1.	Homework without tears	1. Parents Guide to motivating children to do homework 2. Parents' Roles in supporting children's learning at home ❖ Setting the space, time and rules 3. Motivating your child 4. Working with Teachers - Objectives of Partnership 5. Common Homework problems	❖ Facilitator presentation ❖ Interactive discussions and group work ❖ Use of readings and List of Resources
2.	Children's Math Foundations I	1. How children develop math concepts and acquire knowledge ❖ Three types of learning experiences for children : naturalistic, informal and Structured 2. Promoting young children's concept development through problem solving and hands-on learning with peers and adults 3. Fundamental Concepts and Skills in math ❖ The Kindergarten Numeracy Curriculum ❖ What the Primary 1 maths curriculum looks like	❖ Facilitator presentation ❖ Interactive discussions discussions (small groups) and group work with children ❖ Use of readings ❖ Making math teaching / resource kits ❖ Activities to do at home

APPENDIX E Continued

3.	Children's Math Foundations II	1. One-to-one Correspondence 2. Number Sense and Counting ❖ Matching ❖ Counting back and forward ❖ Number Line	❖ Facilitator presentation ❖ Interactive discussions (small groups) and activities with children ❖ Sharing sessions by parents on home activities /projects ❖ Use of readings ❖ Making math teaching / resource kits ❖ Activities to do at home
4.	Children's Math Foundations III	1. Comparing - More, less, same as, taller, shorter 2. Using Graphs 3. Number Bonds - parts and wholes 4. Setting up the Math environment - Dramatic Play, Projects, Books 5. Conclusion and Feedback	❖ Facilitator presentation ❖ Interactive discussions discussions (small groups) and activities with children ❖ Sharing sessions by parents on home activities /projects ❖ Use of readings ❖ Making math teaching / resource kits ❖ Activities to do at home
		Group Interviews with parents to be held at the end of workshop 4 or on an alternative date / venue subject to their availability	

APPENDIX F : Programme for Family Math Workshops

Workshop Session 1 - Outline

As far as possible, the investigator conducted the first session at each of

Activities		Duration	Key Words	Curriculum strands Links to School	Message to Parent Links to Home
Books Welcome	Family gathering time with a variety of math/theme books...			Mathematical language: Communicate effectively by listening and speaking	Help your child look for math in books. Have fun finding and talking about it.
1. Estimating Jar • **Number line**	Estimate grapes in a bunch	5 minutes	zone, range, estimate, guess, size	Number sense and numeration	The more you estimate and the more you talk about it with your child, the better estimator your child will be.
2. Story, song or verse	Monster math picnic	5 minutes	Counting and number words from one to ten	Number sense and numeration	This book features on number bond—different combinations of ten.
3. Graph	Most preferred fruit	5 minutes	More, less, count, compare	Data management	Picture graphs clearly show how many, more, less and the same.
4. Math Walk (treasure hunt)	Look for fruits to add up to ten	5 minutes	More, less, numbers from one to ten	Number sense	Help your child to think of how the number ten can be taken apart and put together in different ways.
5. Table activities - Trying out selected math kits	Modelling of activities by leader 1. Ladybugs and leaves 2. Adding with dominoes 3. Make a number line (in ascending, descending order)	5 minutes 15 minutes	Counting, addition, subtraction	Number sense Operations (addition and subtraction)	Math can be fun. Try to make the learning experience into a game or activity that is enjoyable whenever possible.
6. Estimating Jar • **Number line**	Count the grapes	5 minutes	zone, range, estimate, guess, size	Number sense and numeration	The more we estimate the better we get!

the 10 centres, unless there was a clash in the timing of sessions. The

APPENDIX F Continued
following activities and briefing were conducted at the first Family Math Workshop :

1. Workshop Proceedings : The first 1 hour of the workshop was spent on housekeeping including an explanation of the importance of Math in our daily lives and parents' support of their own children at home. The purpose of conducting the Family math programme was also explained and emphasis was made that math learning can take place through enjoyable games and learning activities using everyday materials and experiences at home and outside home.

How young children learned maths was explained, with particular attention paid to emphasizing the importance of using concrete materials and manipulatives. The sequence of Concept – Connecting –Symbolic development of math concepts was explained and illustrated.

An outline of the Primary Math syllabus was also introduced briefly to parents and how important it was for parents to understand what the math curriculum now looks like.
Parents were divided into small groups of 5-6 to try out selected math kits activities. There was more interaction among parents and the teachers who helped to facilitate the activities. Teachers provided parents with an understanding of how to carry out the activities – and explained to parents how to use them at home with the children.
The concept of the Math kits were also introduced and emphasis on using them to reinforce mastery rather than teach new skills, and creating enjoyment and fun experiences in math was also stressed.
For a detailed session outline, refer to Appendix ____ for the Slides and handouts given during the 1st FMW)

The 2nd and 3rd Family Math Workshops adopted the following standard programme outline :
Theme : Food

The Repeating Activities
Children benefit from structure and repetition when developing mathematical skills and concepts. Exploration and practice lead to greater understanding. Therefore, the following activities will be repeated each week using a variety of materials.

The Estimating Jar and Number Line: Activity #1
The class teacher would begin by welcoming parents and children to the session and as parents walk in, they are invited to participate in an estimation activity.

APPENDIX F Continued

Estimating develops a sense of number. This skill is developed through practice and reflection. The more we do it, the better we become. Estimating also encourages risk-taking and problem solving skills. The concept of having one right answer is discouraged by using a range or "zone" of reasonable guesses. Families will use a paper strip (postit note) that allows for more than one number when guessing. The leader will use a coloured see-through overlay to show the "zone" of reasonable guesses when counting. The overlay will cover 5 numbers with the counted number in the middle.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

The number line provides a visual reference to develop sequence (forwards and backwards), counting on and number relationships (greater than, less than, same)

Welcome: The Literature Connection #2
This is followed by a math story read to the children which is followed by a few games and activities such as graphing, treasure hunt, number bond activities etc. that both parent and child can participate in. During this period, both the investigator and teacher would go to the different groups to facilitate and explain the learning outcomes and ways to encourage and support children's development of math understanding and skills as they engage with the materials given.

Each week will start by offering the families a variety of math and theme related books. Literature creates a bond between child and adult and is therefore a valuable learning tool. Finding the math in stories will help children and families to make mathematical connections with their real world.

The Graph: Activity #3
A picture graph provides a visual means to see more, less or the same. Graphs often involve more than one strand of mathematics and help us to recognize information that is not always obvious. As well as organizing data, graphs develop number concepts and measurement skills.

The Math Walk: Activity #4
This activity helps a family to understand that "math is everywhere"...in the home, yard, community. Math is not only numbers, but many different strands that often interact and overlap. Parents and children need opportunities to recognize these math strands and to realize that math is a part of our every day life.

APPENDIX F Continued

A point to note was that not every centre used the same math activities or concept books - Due to the lack of a standardized teaching curriculum across the 10 centres, teachers were given some liberty to decide which activities would be most appropriate for the children as they would know what math concept they had been teaching during that particular week.

APPENDIX E Continued

Hence, the teacher's knowledge of what to share and reinforce to parents was important to make the connection with the home meaningful and workable. However, the same format and sequence of programme was used across the 10 centres and teachers selected form the same pool of math Activity Kits during the hands-on session with the parents.

The Home Connection #5

Each week, the evening will allow parents and children time to try out selected Math kits. Both the class teacher and investigator would facilitate and help explain how to use the various math kits and the learning value of each kit.

The session was usually rounded off with a summary of the evening's key math concepts and finding out who made the best correct guess in the estimation activity, of which there would be a prize for the 'winner'. To keep the children interested, the teacher would also prepare rewards in the form of 'goodie bags' containing candies, and manipulatives. The children were observed to be very enthusiastic towards the activities and having their parents with them. Also watching the parents', including a few grandparents' commitment in attending and supporting their children's learning was indeed encouraging. Despite the language barrier due to their language proficiency of some parents, they still attended the sessions faithfully and parents who were bilingual even chipped in to help explain and translate what was going on to those Chinese speaking parents.

The evening would conclude with a brief sharing session to review the night's activities and to discuss the math that was found in each activity. Home participation will be encouraged through the Family Math Activity kits which the children get to borrow and use at home after parents have attended the 1st FMW. The families will be given ideas and materials to continue and extend each night's activities. Repeating activities will include a home estimating jar and suggestions for a math walk in their own home or yard.

APPENDIX G : Parent Math Workshops

A teacher showing a child how to record and add the numbers of a series of dominoes while his mother watches and observes

The child counts the number of dots on the dominoes as his mother watches

Another parent observes and guides her son in counting and recording the number of dots

A mother reads and explains the number sentence to her son as he counts the cubes

A child looks up to her mother for affirmation as she works on her number bonds with some broad beans

A group of parents trying out a math kit activity that was earlier demonstrated by the teacher

APPENDIX G Continued

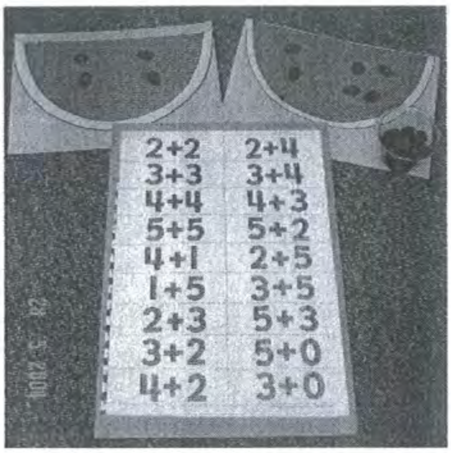
A mother working with her daughter on a seriation activity

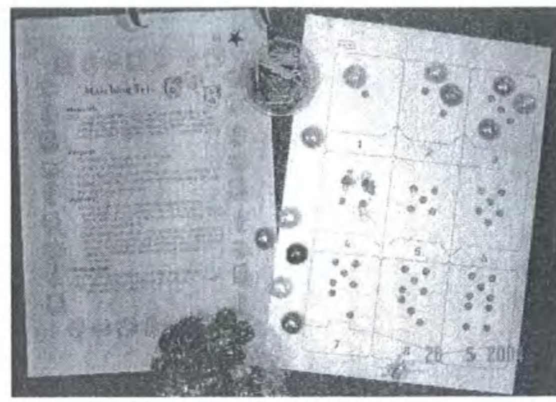
A mother working with her daughter on recording and adding the numbers

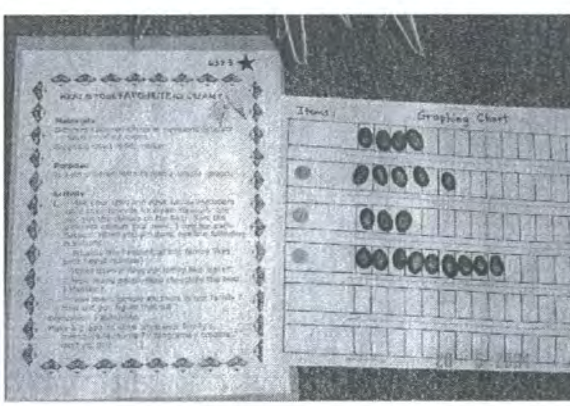
A child steps up to work on a matching and counting activity led by the class teacher during a parents' workshops with the children

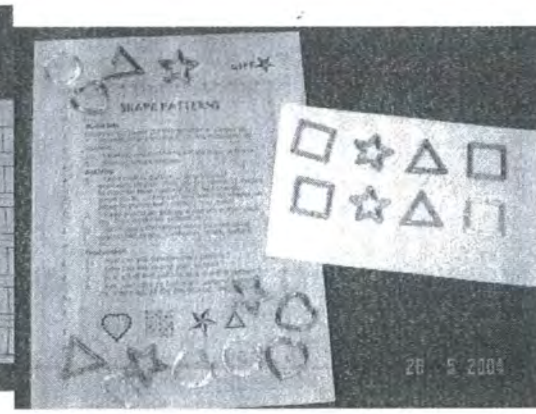
APPENDIX H : Sample of Math Kits

Samples of the math kits that parents borrowed home on a weekly basis during the programme









APPENDIX I : Pilot of the TEMA and Math Criterion Reference Instrument

TEMA – Test of Early Mathematics Ability (TEMA-3)
Third Edition by Herbert P. Ginsburg • Arthur J. Baroody
<u>Brief description :</u>

Ages: 3-0 through 8-11
Testing Time: 40 minutes
Administration: Individual

The TEMA3 is designed to measure the mathematics performance of children between the ages of 3-0 and 8-11. It is generally used as a norm-referenced measure or as a diagnostic instrument to determine specific strengths and weaknesses. The test is designed to be used to measure progress, evaluate programmes, screen for readiness, discover the bases for poor school performance in mathematics, identify gifted students, and guide instruction and remediation. The test measures informal and formal (school-taught) concepts and skills in the following domains: numbering skills, number-comparison facility, numeral literacy, mastery of number facts, calculation skills, and understanding of concepts. It has two parallel forms, each containing 72 items.

The TEMA assessment kit was piloted on three 6 year old children (2 boys, 1 girl) on 26 May Wednesday at Compassvale Centre. Each session (per child) took about 30 mins to complete, starting with items A22 to A46, depending on each child's ability.

The process of assessment time consuming, for each child requiring at least 30-40 mins for the test to be administered Due to the manpower constraint, this posed as an impractical assessment to administer to more than 250 children within a short period of time.

There were also items in the assessment (A20 and A27 -mental number line) that were not understood by the children. Children appeared to be guessing the answers and there was no way to check if the child answered correctly, with understanding.

However, as the TEMA is a norm-referenced maths achievement test and due to the width of the skills covered, it is unlikely to be sensitive to small though important changes in understanding. Also, it is unrealistic to expect major developments in math learning /mastery within a short period of 8-10 weeks and it is deemed that this assessment kit may not be adequately sensitive to measure slight improvements in the child's math ability score.

APPENDIX I Continued

2. Criterion reference math instrument

In light of the above limitations with regard to the use of TEMA, a criterion-reference achievement test in the form of a paper-pencil test was designed instead to determine whether or not a child has acquired a clearly specified math skill. The advantage of this type of test is that it can be designed to assess the appropriate math concepts that were taught, Hence, increasing the ecological validity.

Since the curriculum and math concepts for 6 year olds range from country to country, the pencil paper assessment is deemed more appropriate, as it was designed to suit the local context and study rather than adopting a criterion-referenced tests developed in another country.

The first self-constructed paper-pencil assessment was piloted and administered to four 6 year olds in a group setting which took less than 30 mins to administer and complete. It comprised 33 items : 6 counting (up to 10), 6 ordering of numbers (e.g. What comes before '7'), 6 questions on more - less, 4 items on number line where child fills in the Based on the high scores attained on this pilot, the items appeared to be too easy, and the following changes were made to the test :

1. replace some counting items to include counting of objects up to 20
2. include 2 items on graphing
3. Include number lines with more blanks and in reverse order
4. Simple addition and subtraction (up to 10) with part-whole concept
5. 2-3 items on patterning
6. Introduce some word-picture problem sums on simple addition and subtraction (symbolic additive - number bonds)

The investigator took into consideration the practicality and suitability of

the two assessment modes and adopted the paper and pencil assessment instead as it was better suited and deemed more appropriate for such a large sample since it could be administered in a small group setting (of 5 - 8 children at a time and can be completed in about 30 minutes per group), it is also more practicable and feasible given the constraints of limited manpower (there was no budget to hire research assistants) faced by the investigator. Furthermore, it was deemed necessary that the pre and post test be conducted for all the children within a fairly short duration of time of about 4-5 weeks in order pre -empt any possible maturation effects. The revised assessment included the abovementioned items. Some of the TEMA items were also adapted and included in the paper-pencil task.

APPENDIX J: Brief Report on Pilot conducted on the Parent Involvement instrument

The piloted instrument comprised the following

subscales :Scale Items in Pilot	No. of items
Parent Efficacy	5
General School Invites	6
Specific Teacher Demands	5
Parent Role Construction /Beliefs	6
Knowledge and Skills ,Time and Energy	8
Involvement Activities	9
INVOLVEMENT PROCESSES	
Encouragement	6
Modeling	6
Reinforcement	7
Instruction	5
Status Variables	1-11 on back page

1. A total of 14 questionnaires were sent to two different child care centers that were not included in the study. The questionnaires used two different scales : One set with 6 point scale and another with a 4-point scale.
2. All questionnaires were returned in sealed envelopes and with every item completed, with the exception of parents' e-mail addresses (which is an optional item).

The 4-pt scale

1. For questions 10-20, responses tended to be either all '3' or all '4' for these items
2. Items 21-27 and 44-67 also tended to yield very high scores of '3' and '4', implying that there is a tendency for respondents to give socially acceptable answers.

The 6-pt scale

1. For questions 10-20, responses were more varied and the scores had a better spread
2. Items 21-27 and 44-67 also tended to yield very high scores of '5' and '6', implying that there is a tendency for respondents to give socially acceptable answers.

APPENDIX J Continued

Proposed changes to the questionnaire :

1. To use the 6-point scale as it yields a better range /spread of responses. Using a 6-pt scale may be preferred over the 4-pt scale in the event that they can be interpreted as interval data if there is clear indication that the elements of each subscale are measuring something similar.
2. Some of the previous items were replaced with more specific and pertinent questions that focus on the outcome variable. (qsts 1-6, 13-27 and 28-33 - have been rephrased - instead of 'How True', the question is changed to 'How often?'
3. New items were also added to better capture parents' knowledge and skills in the related domain (i.e. Math homework and understanding of the math curriculum for K2 and Primary 1 transitioning) to better address the research questions. One new item asking parents to select three 'most helpful' means of receiving information from the centers has been added. (please see amended questionnaire)
4. The revised questionnaire now has 51 outcome items and 12 demographic items

Proposed **revised** scale items in final questionnaire	Item numbers
Parent Efficacy & knowledge	11-23
Communication with centre	6-10
How helpful school is	1-5
Parent Role Construction /Beliefs	24-29
Involvement Activities	30-37
INVOLVEMENT PROCESSES	
Encouragement	38-42
Reinforcement	43-45
Status Variables	1-12 (last page)

APPENDIX K : Consent Letter and Form

Dear Parent / Guardian,

Parent Consent Form to participate in a research Study on Parent Involvement in children's math homework

NTUC Childcare centres are working to improve ways to help families support their child's learning at home. We are conducting a research study to explore how home-school partnerships can work to improve children's learning.

The goals of this programme is to provide parents with information and teaching resources that will enable you to support your child learn maths. One of the outcomes of this study is to find out how schools and families can work together to help prepare children to enter into Primary One particularly in the area of fostering parenting skills in supporting child's learning of maths.

The programme will consist of a combination of parent workshops and interactive homework activities. These workshops will help parents learn how to help your child with homework, as well as learn to make teaching resources and conduct learning activities at home to reinforce what your child is learning in school. You will get to make and keep various teaching materials that will help build your child's maths understanding and learning.

In addition, a brief assessment of your child's math skills based on the current classroom curriculum will be made during the period of the study (April – June). I will also collect feedback from you through questionnaires and interviews.

All information collected during this study will be kept confidential. Both yours and your child's names will be kept anonymous and false names will be created when referring to you or your child. No information specifically identifying your child or your family will be revealed to the centre staff, management or other parents. The information collected during this study will be used for research as part of my Doctoral studies in Education I will not share field notes, interview transcripts, or homework samples with anyone except the members of my dissertation committee.

APPENDIX K Continued

Your participation in this study will help us to develop better and more effective programmes to help parents support their child's learning at

home. Your participation in the study is completely voluntary and you have the right to withdraw from the study at any time.

If at any time you wish to withdraw from this study, you need only to tell me or drop me a note /e-mail. There will be no payment for participating in this study, however, a token of appreciation will be given to parents who participate fully in this study.

Kindly complete the attached Consent Form A and return it in the envelope provided before ____________2004. I will be at your child's centre on
_____________________ from 5-6.30 pm if you need to discuss with me any questions you may have concerning this study. You can also contact me at :

Mrs Lim-Chan Lin Ho
Blk 70 Geylang Bahru,
#02-2719, SE 330070

Tel : 63919223 or Fax : 6-2933460
e-mail : linho@rtrc-asia.com

Thank you for your interest in this Project. I look forward to working with you in the near future.

Yours sincerely,

Mrs Lim-Chan Lin Ho
Primary Investigator

APPENDIX K Continued

TITLE OF PROJECT : Parent Involvement in children's math homework

CONSENT FORM

Please complete this form and return it to Ms Chan Lin Ho, using the attached envelope through the centre supervisor :

	Please delete accordingly :
1. Have you read the Letter / Information Sheet ?	YES / NO
2. Have you had an opportunity to ask questions and discuss the study with the investigator ?	YES / NO
3. Have you received satisfactory answers to all of your questions ?	YES / NO
4. Have you received enough information about this study ?	YES / NO
5. Have you spoken to : Mrs Lim-Chan Lin Ho	YES / NO
6. Do you understand that you are free to withdraw from the study :	YES / NO

- At any time and
- Without having to give a reason for withdrawing and
- Without affecting you or your child's position in the Child Care Centre

I * consent / do not consent to my own and my child's participation in this study and I would * allow / not allow the Ms Chan to use the findings for future research publications, conferences and presentations, with the assurance that our identity will be kept strictly confidential and anonymous.

Signed : ______________________________

Name (in Block Letters) : ________________________________

Name of Child : ____

Date : ____________

** Please delete accordingly*

THANK YOU !

APPENDIX L : Parent Math Workshop Evaluation Form

Date of Session: ____________________

Instructor: ____________________

Name of Child Care Centre (Branch) : ____________________

Thank you for attending the Parent Math Workshop 1. We'd like to know what you thought and if it was helpful for you. Please use this form to tell us about your experience.

Tell us about your learning experience:

Please indicate the degree to which you agree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Because of this workshop, I feel more confident in helping my child with his /her math					
2. Because of this workshop, I will be able to make use of materials at home to help my child learn					
3. Overall, I found this workshop useful					
4. The workshop will help me with my parenting skills					
5. The information provided was useful to me					
6. The instructor was knowledgeable.					
7. The activities and materials presented useful					
8. The staff were approachable and helpful					
9. I would recommend this workshop to others.					
10. I would attend another Parent math workshop.					
11. Being able to have this workshop in the Child Care Centre makes it more convenient for me.					
12. The pace of the workshop was ok for me					

APPENDIX L Continued

Feedback questions:

1. What did you like best or find most useful about the session?

2. What did you like least about this workshop?

3. What could be better next time?

4. What ideas / skills did you learn that can be applied to help your child learn at home ?

5. Do you have constructive suggestions for this instructor?

6. Do you have suggestions for future training sessions or topics?

7. Any other comments?

APPENDIX M : Parent Evaluation Family Math Newsletters

Please mark the response which best indicates the direction and strength of your view, and add your comments :

I found the family Math Newsletters to be :

ORGANISATION

5	4	3	2	1
Informative				Not Informative
5	4	3	2	1
Interesting				Not interesting
5	4	3	2	1
Useful				Not useful
5	4	3	2	1
Easy to understand				Difficult to understand
5	4	3	2	1
Beneficial				Not Beneficial

Comments :

____

General

Which type(s) of information in the newsletters is most helpful for parents?

How could the Family Math Newsletters be improved ? What would you include / exclude ?

What other communication do you think would help to provide parents with the information they need to help support their child's learning at home ?

APPENDIX N : Effect Size Table

The following Table shows how η^2 compares with Cohen's *d* classification of effect size (Kinnear, 2004). Cohen (1988) [55] defined effect sizes as "small, *d* = .2," "medium, *d* = .5," and "large, *d* = .8" (p. 25).

Cohen's Standard	Effect Size	η^2 Eta squared
	2.0	.50
	1.9	.47
	1.8	.45
	1.7	.42
	1.6	.39
	1.5	.36
	1.4	.33
	1.3	.30
	1.2	.27
	1.1	.23
	1.0	.20
	0.9	.17
LARGE	0.8	.14
	0.7	.11
	0.6	.08
MEDIUM	0.5	.06
	0.4	.04
	0.3	.02
SMALL	0.2	.01
	0.1	
	0.0	

Effect size [56] (Partial Eta squared)	Size of Effect
<0.01 (<1%)	Small
0.01 to 0.10 (1-10%)	Medium
>0.10 (>10%)	Large

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[55] Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.

[56] The above interpretation of partial Eta squared is cited from Clark-Carter (1997)

APPENDIX O: Average Monthly Household Income, 2000

Census 2000 selected datapoints

Individual Income
Average individual income: $2234 (median)
11.7% of individuals have income below $1000
30.4% of individuals have income between $1000 and $2000
23.6% of individuals have income between $2000 and $3000
13.5% of individuals have income between $3000 and $4000
20.7% of individuals have income at least $4000
(percentages do not add up to 100% due to rounding)

Household Income
Average household income: $3607 (mean)
Average household income: $4943 (median)
12.6% of monthly household income less than $1000.
10.3% of monthly household income more than $10,000.
* *High-income household defined as income above $8000*
* *Low-income household defined as income below $2000*

Family structure
15.5% of males above 40 are unmarried.
14.1% of females above 40 are unmarried.
14.2% of ever-married females (30-39 years old) have no children.
6.4% of ever-married females (40-49 years old) have no children.
9.4% of ever-married females (university graduates) have no children.
82.1% of households are one-family nucleus.
Average household size is 3.7

Population Structure
Total Population as of 30 June 2000: 4,017,733 (approx 4 million).
74.0% Citizens
7.2% Permanent Residents
18.8% Non-Residents
1.3% Growth rate for citizens
10.0% Growth rate for PRs
9.3% Growth rate for non-residents
81.7% of residents are born in Singapore.

Source:
* Singapore Department of Statistics homepage Singapore Census of Population 2000
* Monetary Authority of Singapore Monthly Statistical Bulletin Database

Bibliography

Alexander, K.L., Entwisle, D.R. (1988). Achievement in the first two years of school : Patterns and processes. Monographs of the Society for Research in Child Development,53, Serial No.218.

Ames, C. (1993). How school-to-home communications influence parent beliefs and perceptions. Equity and Choice, 9(3), 44–49.

Ashton, P., Webb, R., & Doda, N. (1983). A study of teachers' sense of efficacy. Final report, Executive summary. Florida University. Gainesville. (ERIC Document Reproduction Service No. ED231835).

Aubrey,C. and Godfrey,R. (2003). 'The development of children's early numeracy through key stage 1', British Educational Research Journal, 29:6, 821 – 840

Aubrey,C.,Bottle,G. and Godfrey,R. (2003). 'Early Mathematics in the Home and Out-of-Home Contexts', International Journal of Early Years Education, 11:2, 91 – 103

Baker, A. J. L., Piotrkowski, C. S., & Brooks-Gunn, J. (1998). The effects of the Home Instruction Programme for Preschool Youngsters (HIPPY) on children's school performance at the end of the programme and one year later. Early Childhood Research Quarterly, 13(4), 571–588. EJ580313.

Baker, A. J. L., & Soden, L. M. (1998). The Challenges of parent Involvement Research. ERIC/CUE Digest no 134. ED419030.

Balli, S. J., Demo, D. H., & Wedman, J. F. (1998). Family involvement with children's homework: An intervention in the middle grades. Family Relations, 47(2), 142–146.

Balli, S. J. (1998). When Mom and Dad help: Student reflections on parent involvement with homework. Journal of Research and Development in Education, 31(3), 142-46.

Bandura,A.(1986). The explanatory and predictive scope of self-efficacy theory. Journal of Social and Clinical Psychology, 4(3), 359-373.

Bandura,A.(1993).Perceived self-efficacy in cognitive development and functioning. Educational Psychologist, 28 117 –148.

Bandura, A.(1995).Exercise of personal and collective efficacy in changing societies. In A. Bandura (Ed.), Self-efficacy in changing societies (pp. 1-45). New York:Cambridge University Press.

Bandura, A., Barbaranelli, C. Caprara, G.V., & Pastorelli,C. (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. Child Development, 67, 1206-1222.

Bandura,A.(1997).Self-efficacy: The exercise of control NewYork: W.H.Freeman.

Baratta-Lorton, M. (1995). Mathematics their way. USA : Addison Wesley.

Baratta-Lorton, M. (1995). Workjobs II. Number activities for early childhood. CA : Addison Wesley.

Bourdieu, P. (1977). Cultural reproduction and social reproduction. In J. Karabel & A. Halsey (Eds). Power and ideology in education (pp. 487 – 510). New York:Oxford University Press.

Bowman, B. (1998). "Math, science and technology in early childhood education". Paper presented at the Forum on early Childhood Science, mathematics and Technology Education, Washington, DC. (ERIC Document Reproduction Service No. ED 418774)

Brock-Utne,B. (1996). Reliability and validity in qualitative research within education in Africa. International Review of Education, 42 (6), 605-21.

Bronfenbrenner, U. (1979). The ecology of human development : Experiments by nature and design. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. Developmental Psychology, 22, 723-742.

Brooks,G., and Hutchinson,D. (2000). Family Numeracy adds on; London:Basic Skills Agency.

Brown, G. (2003). What it takes to support school readiness : Building Collaborative partnerships. Program Services Paper. North Carolina Partnership for Children, Raleigh Eric Document : ED 473698

Bruner,J.S. (1987). Making sense : the child's construction of the world. London:Methuen.

Bryman,A. and Cramer, D. 2005. Quantitative data analysis with SPSS 12 and 13 : a guide for social scientists. London : Routledge.

Campbell, D.T. and Stanley, J. (1963). Experimental and quasi-experimental designs for research on teaching. In N. gage (ed.) Handbook of Research on Teaching. Chicago : Rand McNally, 171-246.

Carver, R. H. Nash, J. G. 2005. Doing data analysis with SPSS version 12.0. Belmont, CA : Thomson/Brooks-Cole.

Catsambis, S. (2001) Expanding knowledge of parental involvement in children's secondary education : Connections with high school seniors' academic success. Social Psychology of Education.(5), 149-177.

Charlesworth,R. (2000). Experiences in math for young children. USA: Delmar.

Christenson, S. L., & Sheridan, S. M. (2001). Schools and families: Creating essential connections for learning. New York: Guilford Press.

Clark, R. (1993). Homework-focused parenting practices that positively affect student achievement. In N. F. Chavkin (Ed.), Families and schools in a pluralistic society (pp. 85–105). Albany, NY: State University of New York.

Clark-Carter, D. (1997). Doing quantitative psychological research : From design to report. Hove, East Sussex: Taylor & Francis : Psychology Press.

Clements, D. (2001). Mathematics in the Preschool. Teaching Children Mathematics, 7(5). 270-276.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates

Cohen, L., Manion, L. & Morrison, K. (2000). Research methods in education. 5th edition. Routldge Falmer.: London.

Coleman,J. (1991). Parent involvement in education. (Report No. PIP-91-983). Washington DC : U.S. Government Printing Office. (ERIC Document Reproduction Service No. ED 334028).

Coleman,J. (1998). Social capital in the creation of human capital. American Journal of Sociology, 94. 95-120.

Coleman, P.K. & Karraker, K.H. (1998). Self-efficacy and parenting quality : Findings and future applications. Developmental Review, 18, 30-46.

Coleman, P.K. & Karraker, K.H. (2000). Parenting self-efficacy among mothers o school-age children : conceptualization, measurement and correlates. Family Relations, 49, 12-24.

Comer, J. P., & Haynes, N. M. (1991). Parent involvement in schools: An ecological approach. The Elementary School Journal, 91(3), 271-77.

Cook,T., Campbell,D.T. (1979). Quasi-Experimentation : Design and Analysis Issues for Field Settings. Boston : Houghton Mifflin.

Cotten, K. & Savard, W.G. Parent Involvement in Instruction K-12. Research Synthesis. 1982. Morton-Williams, R. "The Survey of Parental Attitude and Circumstances, 1964." in Craft, M. ed. Family, Class and Education. London: Longmann, 1970.

Denton, D. (2001). Improving children's readiness for school : Preschool programmes make a difference, but quality counts ! Atlanta, GA : Southern Regional Education Board

Desforges,C. and Abouchaar,A. (2003). The impact of parental involvement, parental support and family education on pupil achievement and adjustment : A Literature Review. Research Report No. 433. Department for education and skills. Queen's Printer.

Desimone, L (1999). Linking parent involvement with student achievement: Do race and income matter?. The Journal of Educational Research, 93 (1), 11-30

Drummond,K.V., and Stipek,D. (2004). Low income parents' beliefs about their role in children's academic learning. The Elementary School Journal, Jan 2004, 104 (3). Pp. 197-213.

Emig, C. (2000). School readiness : helping communities get children ready for school and schools ready for children. Child Trends Research Brief. Child Trends Inc. Washington.

Epstein, J.L. (1986) . Parents Reactions to Teacher Practices of Parent Involvement. Elementary School Journal, 86, 3 (January): 277-94. EJ 337 873.

Epstein, J. (1987). Toward a theory of family-school connections: Teacher practices and parent involvement. In K. Hurrelmann, F. Kaufmann, & F. Losel (Eds.), Social interventions: Potential and constraints (pp. 121-135). New York: Walter de Gruyter.

Epstein, J.L., & Salinas, K.C. (1993). School and family partnerships: Surveys and summaries. Centre on Families, Communities, Schools and Children's Learning.

Epstein, J. (1995). School family and community partnerships : Caring for the children we share. Phi Delta Kappa, 76(9), 701-712.

Epstein, J. L., Croates, L., Salinas, K. C., Sanders. M. G., & Simon, B. S. (1997). School, family, and community partnerships: Your handbook in action. Thousand Oaks, CA: Corwin Press.

Epstein, J. L. (2001). School, family, and community partnerships: Preparing educators and improving schools. Boulder, Colorado: Westview Press.

Faires, J., Nichols, W.D., & Rickelman, R.J. (2000). Effects of parental involvement in developing competent readers in first grade. Reading Psychology, *21*, 195-215.

Feuerstein, A. (2000). School characteristics and parent involvement : Influences on participation in children's schools. The Journal of educational research, September/October 2000 Vol. 94 (1).

Flexer, R. J., & Topping, C. L. (1988). Mathematics on the home front. Arithmetic Teacher, 36(2), 12-19.

Fullan,M. (2001). The New Meaning of Educational Change (3rd ed.), Teachers College Press, Columbia University. New York, NY.

Gailey, S. K. (1993). The mathematics-children's-literature connection. Arithmetic Teacher, 40(5), 258-261.

Galloway, J., & Sheridan, S. M. (1994). Implementing scientific practices through case studies: Examples using home-school interventions and consultation. Journal of School Psychology, *32*(4) 385-413.

Garland,C. (1990). Mathematics Their way Summary newsletter. California : Centre for Innovation in Education.

Garson, D. (2007). Testing of Assumptions. Retrieved on 1 April 2007. http://www2.chass.ncsu.edu/garson/pa765/assumpt.htm

Goodnow,J.J.(1988).Parents' ideas, actions, and feelings: Models and methods from developmental and social psychology. Child Development, 59 286 –320.

Guha, S. (2000). Eyes to see and ears to hear : teaching math in the childhood years. Integrating math in children's learning centres. ERIC Clearinghouse on Elementary and Early Childhood Education : Urbana, IL. (ERIC Document Reproduction Service No. ED 438177).

Hara, S. R., & Burke, D. J. (1998). Parent involvement: The key to improved student achievement. School Community Journal, 8(2), 9-19.

Harris, Louis, et al. The American Teacher 1987: Strengthening Links Between Home and School. Conducted for Metropolitan Life Insurance Co., New York: Louis Harris and Associates, Inc. 1987.

Henderson, A. T., & Berla, N. (Ed.) (1994). A new generation of evidence: The family is critical to student achievement. Washington, DC: Centre for Law and Education.

Henderson,A.T, and Mapp,K.L. (2002). A new wave of evidence : the impact of school, family and community connections on student achievement Annual Synthesis 2002. USA : Southwest Educational Development Laboratory.

Hohmann,C. (1991). Mathematics : Highscope K-3 Curriculum Series. Michigan: Highscope Press.

Hoover-Dempsey, K. V., Bassler, O. C., &Brissie, J. S. (1992). Explorations in parent-school relations. Journal of Educational Research, 85, 287–294.

Hoover-Dempsey, K. V., Bassler, O. C., & Burow, R. (1995). Parents' re-ported involvement in students' homework: Strategies and practices. Elementary School Journal, 95, 435–450.

Hoover-Dempsey, K. V., & Sandler, H. M. (1995). Parental involvement in children's education: Why does it make a difference? Teachers College Record, 95, 310–331.

Hoover-Dempsey, K. V., & Sandler, H. M. (1997). Why do parents become involved in their children's education? Review of Educational Re-search, 67(1), 3–42.

Hoover-Dempsey, K. V., Battaito, A. C., Walker, J. M. T., Reed, R. P., DeJong, J. M., and Jones, K. P. (2001). Parental Involvement in homework. Educational Psychologist, 36(3), 195-209.

Hoover-Dempsey, K.V., Walker, J.M.T., Jones, K.P., & Reed, R.P. (2002). Teachers Involving Parents (TIP): An in-service teacher education programme for enhancing parental involvement. Teaching and Teacher Education, 18 (7), 1-25.

Hoover-Dempsey, K.V., & Sandler, H.M. (2001-2004). Parental Involvement in Children's Education: A path to achievement, IES #R305T010673-02.

Hoover-Dempsey, K.V., et al. (2004). Final Performance Report for OERI/IES Grant #R305T010673: The Social Context of Parental Involvement--A Path to Enhanced Achievement. Presented to Project Monitor, Institute for Education Sciences, U.S. Department of Education, Washington DC.

Hughes,M. (1983). Teaching arithmetic to pre-school children. Educational Review 35(2), 162-73.

Izzo, C. V., Weissberg, R. P., Kasprow, W. J., & Fendrich, M. (1999). A longitudinal assessment of teacher perceptions of parent involvement in children's education and school performance. American Journal of Community Psychology, 27(6), 817–839.

Kagitcibasi, C., Sunar, D., & Bekman, S. (2001). Long-term effects of early intervention: Turkish low-income mothers and children. Applied Developmental Psychology, 22, 333–361.

Kinnear, P. R. and Gray ,C.D. (2004). SPSS 12 made simple. Hove, East Sussex : Psychology Press.

Kirkby, D. (1992) Games in the teaching of mathematics, Cambridge: CUP

Klein, A., Starkey, P., & Wakeley,A. (1998). Supporting pre-kindergarten children's readiness for school mathematics. ERIC

Clearinghouse on Elementary and early Childhood Education : Urbana, IL. (ERIC Document Reproduction Service No. ED 429691).

Lareau, A. (1987). Social class differences in family-school relationships: The importance of cultural capital. Sociology of Education, 60(2), 73–85. EJ353123.

Lareau, A., & Horvat, E. M. (1999). Moments of social inclusion and exclusion: Race, class, and cultural capital in family-school relationships. Sociology of Education, 72(1), 37–53. EJ590423.

Lee, S. (1994). Family-school connections and students' education ; Continuity and change of family involvement from middle grades to high school, Baltimore, MD: unpublished doctoral dissertation. Department of Sociology, John Hopkins University.

Love,J.M., Aber,J.A., and Brooks-Gunn,J. (1992). Strategies for assessing community progress toward achieving the first national goal. Princeton, NJ : Mathematica Policy Research, Inc.

Lynch, J. (2002). Parents' self-efficacy beliefs, parents' gender, children's reader self-perceptions, reading achievement and gender, Journal of Research in Reading, 25 (1), 54-67.

Marcon,R. (1996). Making the transition from the early to the later childhood grades. A paper presented at the biennial conference on human development. Birmingham, AL.

Marcon, R.A. (1999). Positive relationships between parent school involvement and public school inner-city preschoolers' development and academic performance, School Psychology Review, 28 (3), 395-412.

Martinez-Pons, M. (1996). Test of a model of parental inducement of academic self-regulation. Journal of Experimental Education, 64, 213-227.

Mathematica Policy Research, Inc., and Centre for Children and Families at Teachers College, Columbia University (2001). Building their futures: How Early Head Start programmes are enhancing the lives of infants and toddlers in low-income families. Washington, DC: Administration on Children, Youth, and Families, Department of Health and Human Services.
http://www.acf.dhhs.gov/programmes/core/ongoing_research/ehs/ehs_reports.html

McDermott, R. P., Goldman, S. V., &Varenne, H. (1984). When school goes home: Some problems in the organization of homework. Teachers College Record, 85, 391–409.

McGillicuddy-DeLisi, A.V.(1992). Parents' beliefs and children 's personal-social development. In I.E.Sigel,A. V.McGillicuddy-DeLisi,&J.J.Goodnow Eds.), Parental belief systems: Their psychological consequences for children (pp.115 –142). Hillsdale, NJ:Lawrence Erlbaum.

Melhuish, E., Sylva, C., Sammons, P., Siraj-Blatchford, I., and Taggart, B. (2001). Social behavioural and cognitive development at 3-4 years in relation to family background. The effective provision of pre-school education, EPPE project (Technical paper 7). DfEE. London: The Institute of Education.

Miedel, W. T., & Reynolds, A. J. (1999). Parent involvement in early intervention for disadvantaged children: Does it matter? Journal of School Psychology, 37(4), 379–402. EJ607658.

Miesels, S.J. (1999). Assessing readiness. In R.C. Pianta and M.Cox (Eds) The transition to kindergarten : Research, policy, training and practice. Baltimore, MD: Paul Brookes Publishers.

Miles, M.B., Huberman,A,M. (1994). An expanded sourcebook: Qualitative Data Analysis. Thousand Oaks. London: Sage Publications.

Ministry of Education, Singapore. "HOME, SCHOOL & COMMUNITY PARTNERSHIPS". 2000. Retrieved on 8 June, 2004 from http://www1.moe.edu.sg/compass/foreword.html

Ministry of Education, Singapore. A Framework for a Kindergarten Curriculum in Singapore. Retrieved 29 December, 2006, from http://www.moe.gov.sg/preschooleducation/curriculum_framework.htm

"What research Says about parent involvement in Children's Education In Relation to Academic Achievement" http://www.michigan.gov/documents/Final_Parent_Involvement_Fact_Sheet_14732_7.pdf

Ministry of Education. (2003). Nurturing early learners : Numeracy. Preschool Education unit : MOE

Mitchell,M. Jolley,J. (2001). Research design explained. 4th edition. US: Thomson Learning

National Association for the Education of Young Children. (1990). NAEYC Position Statement on School Readiness. Young Children, 46(1), 21-23.

National Council of Jewish Women. (1996). Parents as school partners: Research report. New York: ERIC Clearinghouse on Urban Education/Columbia Teachers College. http://eric-web.tc.columbia.edu/families/NCJW_child/index.html

Nechyba, T., McEwan, P., and Older-Aguilar, D (1999). "The impact of family and community resource on student outcomes: An assessment of the international literature with implications for New Zealand". Available from: http: www.minedu.govt.nz/web/document/document_page.cfm?id=5593&p=58

O'Connell, S. R. (1992). Math pairs: Parents as partners. Arithmetic Teacher, 40(1), 10-12.

Oppenheim, A. (1992). Questionnaire Design, Interviewing and Attitude Measurement. London:Cassell.

Orman, S. A. (1993). Mathematics backpacks: Making the home-school connection. Arithmetic Teacher, 40(6), 306-308

Pelletier,J. and Brent, J.M. (2003). Parent participation in children's school readiness : The effects of parental self-efficacy, cultural diversity and teacher strategies. International Journal of early Childhood, 34 (1). Issn. 0020-7187

Peña, D. C. (2000). Parent involvement: Influencing factors and implications. The Journal of Educational Research, 94(1), 42–54. EJ615791.

Peth-Pierce, Robin. Undated. "A good beginning : Sending America's children to school with the social and emotional competence they need to succeed." Bethesda, MD: The child Mental Health Foundations and Agencies Network.

Pianta,R.C., and Walsh,D.J. (1996). High risk children in the schools : Creating sustaining relationships. New York: Routledge

Pianta, R.C., Kraft-Sayre, M., Rimm-Kaufman, S., Gercke, N., and Higgins, T. (2001). Collaboration in building partnerships between families and schools: The national centre for early development and learning's kindergarten transition intervention, Early Childhood Quarterly, 16, 117-132.

Pianta, R. (2002). School readiness : a focus on children, families, communities and schools. Office of educational research and improvement, Washington.

Pratt, M. W., Green, D., MacVicar, J. & Bountrogianni, M. (1992). The mathematical parent: Parental scaffolding, parent style, and learning outcomes in long-division mathematics homework. Journal of Applied Developmental Psychology, 13(1), 17–34.

Quigley, D. D. (2000, April). "Parents and teachers working together to support third grade achievement: Parents as learning partners." Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Rimm-Kaufman,S.E.,Pianta,R.C. and Cox, M.J. (2000). Teacher's judgements of problems in the transition to kindergarten. Early Childhood Research Quarterly, 15(2), 147-166.

Rogers P. J. and Miller J. V., (1984) "Playway Mathematics: Theory, Practice, and Some Results," Educational Research *26*, pp. 200–207.

Sacker, A., Schoon, I., and Bartley, M. (2002). Social inequality in educational achievement and psychological adjustment throughout childhood: magnitude and mechanisms. Social Science and Medicine, 55, 863-880.

Sanchez, R.P., & Baquedano, M. M. (1993). "Curriculum of the home and mathematics achievement." Paper presented at the Fifth Annual International Roundtable on Families, Communities, Schools, and Children's Learning, Atlanta.

Schwartz,W. (1999). Family Math for Urban Students and Parents. ERIC/CUE Digest,Number 146. ED432630 1999-07-00 retrieved on 2 August 2004 from http://www.eric.ed.gov/ERICDocs/data/ericdocs2/content_storage_01/0000000b/80/2a/2e/26.pdf

Seefeldt, C., Denton, K., Galper, A, A. & Younoszai, T. (1999). The relation between head Start parents' participation in a transition demonstration, education, efficacy and their children's academic abilities. Early Childhood Quarterly, 14(1), 99-109.

Sheldon,S., and Epstein, J.L., &. (2001). "Focus on math achievement : effects of family and community involvement." Paper presented to the Annual Meeting of the American Sociological Association, Anaheim CA.

Shanmugaratnam,T. (2003). Opening Address at the COMPASS CONVENTION ON SATURDAY 13 SEPTEMBER 2003 Retrieved 18 October, 2004 from http://www.moe.gov.sg/speeches/2003/sp20030913.htm

Shanmugaratnam, T. (2005). Speech delivered at the ASSOCIATION OF MUSLIM PROFESSIONALS (AMP)'S LAUNCH OF MATHS @ HOME LEARNING

KIT FOR PARENTS ON SATURDAY, 19 FEBRUARY 2005 Retrieved 5 September 2006 from http://www.moe.gov.sg/speeches/2005/sp20050219a.htm

Shanmugaratnam,T. (2006). Key note Address at the PAP COMMUNITY FOUNDATION'S 20TH ANNIVERSARY CELEBRATION DINNER ON FRIDAY, 19 MAY 2006. Retrieved 2 July, 2006 from ttp://www.moe.gov.sg/speeches/2006/sp20060519.htm

Shaver, A. V., & Walls, R. T. (1998). Effect of Title I parent involvement on student reading and mathematics achievement. Journal of Research & Development in Education, 31(2), 90-97.

Shonkoff, J. P., & Phillips, D. A., eds. (2000). From neurons to neighborhoods: The science of early childhood development. Washington, DC: National Academy Press.

Shumow, L. (1998). Promoting parental attunement to children's mathematical reasoning through parent education. Journal of Applied Developmental Psychology, 19(1), 109–127.

Simmons, R. K., Stevenson, B. A., & Strnad, A. M. (1993). Stewart Community School: A pioneer in home-school partnership. In R. C. Burns (Ed.), Parents and schools: From visitors to partners (63-76). Washington, DC: National Education Association

Singapore Department of Statistics. Households and Housing Characteristics, Chapter 3. Retrieved on 29 December 2006 from http://www.singstat.gov.sg/keystats/annual/ghs/r2/chap3.pdf

Singapore Department of Statistics. Singapore census of population, 2000, Advance Data Release No.7. Household Income Growth and Distribution. Retrieved on 29 December 2006, from http://www.singstat.gov.sg/papers/c2000/adr-hhinc.pdf

Siraj-Blatchford, I., Sylva, K., Muttock, S., Gilden, R., and Bell, D. (2002), Researching effective pedagogy in the early years (Research report RR356). Institute of Education, University of London.

Smith,S. (1998). Early childhood mathematics : ERIC Clearinghouse on Elementary and early Childhood Education : Urbana, IL. (ERIC Document Reproduction Service No. ED416994).

Starkey, P., & Klein, A. (2000). Fostering parental support for children's mathematical development: An intervention with Head Start families. Early Education and Development, 11, 659-81.

Stenmark, J., Thompson, V., Cossey, R.. (1986). Family math. Berkeley, CA: University of California, Lawrence Hall of Science

Sui-Chu, E.H., & Willms, J. D. (1996). Effects of parental involvement on eighth-grade achievement. Sociology of Education, 69(2), 126–141.

Stearns, M. S., & Peterson, S. (1973). Parent involvement in compensatory education programmes: Definitions and findings. Washington, DC: Office of Education, Department of Health, Education and Welfare.

Suydam, M., & Higgins, J. (1977). Activity-based learning in elementary school mathematics: Recommendations from research. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education. (ERIC Document Reproduction Service No. ED 144 840)

Sylva, K., Melhuish, E., Sammons, P., and Siraj-Blatchford, I. (1999) The Effective Provision of Pre-School Education (EPPE) Project: technical paper 2; characteristics of the EPPE Project sample at entry to the study, London: University of London, Institute of Education

Tizard, B., Blatchford P., Burke, J., Farquhar, C. & Plewis, I. (1988) Young Children at School in the Inner City (Hove, Lawrence Erlbaum Associates.

Tizard, J.; Schofield, W.N.; & Hewison, J. (1982). Collaboration Between Teachers and Parents in Assisting Children's Reading. British Journal of Educational Psychology (52, Part 1): 1-11.

Trochim, W,M. (2001). The Research Knowledge Base. 2nd Edition. Internet Retrieved on 2 August 2005 at http://trochim.human.cornell.edu/kb/index.htm

Topping, K., and Bamford,J. (1998). Parental involvement and peer tutoring in mathematics and science. London. David Fulton Publishers.

Trusty, J. (1999). Effects of eighth-grade parental involvement on late adolescents' educational experiences. Journal of Research and Development in Education, 32(4), 224–233. EJ598231.

Walberg, H. (1984) Families as Partners in Educational Productivity. Phi Delta Kappan. (February).

Walker, J.M.T., Wilkins, A.S., Dallaire, J.R., Sandler, H.M., & Hoover-Dempsey, K.V. (in press). Parental involvement: Model revision through scale development. Elementary School Journal

West, J. M. (2000). Increasing parent involvement for student motivation. Armidale, New South Wales, Australia: University of New England (ERIC Document Reproduction Service No. ED 448411)

Westat and Policy Studies Associates. (2001). The longitudinal evaluation of school change and performance in Title I schools. Washington, DC: U.S. Department of Education, Office of the Deputy Secretary, Planning and Evaluation Service. http://www.ed.gov/offices/OUS/PES/esed/lescp_highlights.html

Wong, A. Senior Minister of State for Education and MP for Tampines GRC (Changkat) at PCF Changkat Education Centre's Graduation Ceremony on 11 Nov 2000 (Sat) http://www.moe.gov.sg/speeches/2000/sp11112000.htm

Zellman, G.L., and Waterman, J.M. (1998). Understanding the impact of parent school involvement on children's educational outcome, The Journal of Educational Research, 91 (6), 370-380